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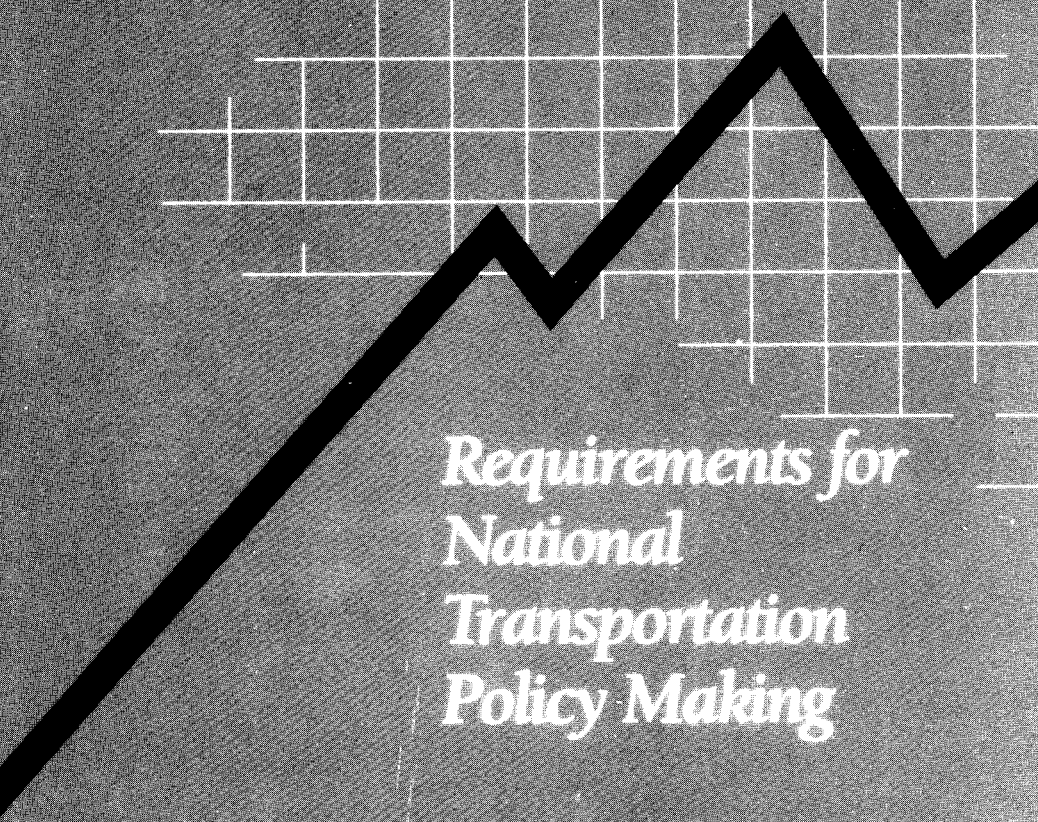
Data for Decisions



Requirements for National Transportation Policy Making

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Data for Decisions

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Preface

Data provide critical input for informed decision making, but they rarely have a champion. Because they are viewed as support for other essential activities, data are often not accorded high visibility or priority in budget allocations. Transportation data are no exception. When U.S. Department of Transportation (DOT) Secretary Samuel Skinner launched a strategic planning process in 1989 to assess the future direction of transportation activities, he found significant deficiencies in the data needed to characterize the use and performance of the nation's transportation system.

Fortunately, momentum for change is building. Since this report was completed, the U.S. Congress passed legislation reauthorizing surface transportation programs. The bill provides for creation of a new Bureau of Transportation Statistics within DOT with a mandate to improve the quality and comparability of transportation data. Secretary Skinner has already committed to the development of a permanent strategic planning capability at DOT and has taken initial steps to strengthen the department's data programs to support his role as chief advisor on national transportation policies.

As part of this initiative, the secretary requested and funded this study to provide an independent assessment of the data needed for national transportation decision making and the institutional changes required within the department to ensure that a permanent data capability is established. To carry out these tasks, the Transportation Research Board of the National Research Council formed a study committee under the leadership of Lillian C. Liburdi, Director of the Port Department of The Port Authority of New York and New Jersey. The committee included 14 experts on transportation policy and impacts, data management and statistics, and information technology; committee members represented major providers and users of transportation data in state and local government and the private sector. The findings and recommendations of the committee's study are presented here.

Nancy Humphrey managed the study, and with the assistance and advice of Alan Pisarski, consultant to the project, drafted the final report under the guidance of the committee and supervision of Robert E. Skinner, Jr., Director for Special Projects. Valuable information about existing transportation data programs and methods of organizing transportation statistics was provided to the committee by the agency

liaisons and the following special representatives of the DOT operating administrations and Statistics Canada: Jane H. Bachner, Federal Railroad Administration; Patricia S. Beardsley, Federal Aviation Administration; David Dodds, Statistics Canada; William B. Ebersold, Maritime Administration; Santo J. LaTores, Research and Special Programs Administration; David R. McElhaney, Federal Highway Administration; Sherry A. Richardson, U.S. Coast Guard; William H. Walsh, Jr., National Highway Traffic Safety Administration; and Samuel L. Zimmerman, Urban Mass Transportation Administration.

Additional input on transportation-related data programs was provided by the Bureau of the Census, the U.S. Department of Agriculture, the Bureau of Economic Analysis, and the Bureau of Labor Statistics. Interviews with the staff of selected federal statistical agencies, including the National Center for Education Statistics, the Energy Information Administration, and the proposed Center for Environmental Statistics, also provided valuable insight on how the data programs of other federal agencies are organized. Special appreciation is expressed to Marguerite Schneider and Frances Holland for assistance in typing drafts of the manuscript.

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Executive Summary

The safe and efficient performance of the U.S. transportation system is critical to economic growth, national security, and the mobility of all citizens. As steward of the nation's transportation system, the Secretary of the U.S. Department of Transportation (DOT) is responsible for developing policies and programs that improve system performance and anticipate future needs.

In 1989 the DOT Secretary initiated a strategic planning process in order to take stock of the state of the nation's transportation system—the first such national assessment in more than a decade. The process revealed significant deficiencies in data on the use and performance of the transportation system, prompting the department to request an independent study by the Transportation Research Board of the data requirements to support strategic transportation policy making and the institutional changes necessary to make these data available on a permanent basis.

The special committee that was appointed to carry out the study concurred with the secretary's assessment that the data to inform national transportation policy making are seriously inadequate and concluded that the organization of data activities in the department is not conducive to providing them. The decentralized, modally focused data programs of DOT, although appropriate to the missions of the operating administrations, are not well structured to address the strategic, cross-cutting, systemwide issues that face the department today. To ensure that the secretary, Congress, and the transportation community have a more solid knowledge base to support investment and regulatory decisions, which involve billions of dollars, the committee recommends the following:

- Immediate establishment of a transportation data center (TDC) within DOT, preferably by legislative mandate, to provide a focal

point for the compilation and integration of systemwide transportation data;

- Development of a national transportation performance monitoring system (NTPMS) by the center to track key indicators of the nation's transportation system and its environment from the viewpoint of markets and users;
- Preparation of a biennial report by TDC on the state of the nation's transportation system, containing a summary and analysis of trends in system performance and impacts; and
- Annual funding of $20 million initially to support a qualified director, full-time professional staff, and start-up for the activities of TDC, including national surveys of passenger and freight flows; and sustained long-term funding to ensure continuity of data for monitoring and policy analysis.

The committee urges that the department move quickly on these recommendations. The breadth and complexity of the issues facing the department today in a rapidly changing environment demand strengthening of the resources committed to data collection and analysis, enabling policy to be founded on informed decision making.

ROLE OF DATA IN NATIONAL POLICY MAKING

The 1966 legislation that established DOT (Pub.L. 89-670) gave the secretary a broad mandate to develop and coordinate transportation policies and programs that provide for the safe and efficient movement of goods and people, support economic growth, serve the national defense, provide for the general welfare, and contribute to such other national goals as resource conservation. Most of the major modes of transportation—highways, rail, public transit, air, water, pipeline, and even emerging modes, such as commercial space transport—are represented under the DOT umbrella. The department, however, evolved as a decentralized modally oriented group of operating administrations, reflecting the modal structure of DOT at its founding, the modal orientation of the transportation regulatory process, the initial focus of the department on the construction and expansion of the major modal transportation networks, and, not least, the modal orientation of the congressional committees that oversee the department's programs.

Globalization of the economy, deregulation of the major transportation industries, and technological change have dramatically changed

the context in which the department operates today. Passenger and freight travel are becoming increasingly intermodal as travelers and shippers search for the safest, most efficient and reliable combination of transport modes. Strategic issues revolve around how well the U.S. transportation system performs and the modes interact to contribute to economic growth and competitiveness in world markets and the safety and mobility of personal travel. Transportation policies are also being shaped by other national objectives—environmental quality, energy efficiency, and national security—making it important to understand how transportation contributes to or detracts from these other national goals.

The data programs of the department have not kept pace with this changing policy environment. Cross-cutting data programs, which involve multiple modes and provide basic information about the use of the system, such as national surveys of passenger and freight movements, were curtailed or eliminated during the 1980s. The data programs of the operating administrations, which constitute the majority of the department's statistical programs, lack common frameworks, definitions, and assumptions, making it virtually impossible to look across individual modes at systemwide performance. National assessments of the status of the transportation system are conducted sporadically; the recent strategic plan was the first comprehensive look at the entire system since 1979. Finally, in contrast with many other federal agencies, the department lacks a permanent entity that is responsible for ensuring that the data and analyses to inform decision makers on national policy issues are available on a consistent, reliable, and continuing basis.

Deficiencies in the availability, coverage, and quality of data for national transportation policy making hamper the ability of the secretary to analyze and address fundamental questions that affect a wide range of regulatory and investment policies. As many of the following examples show, however, data alone may prove insufficient to address the full complexity of these issues without complementary special analyses and research.

- Safety is one of the department's top priorities, yet the secretary and Congress cannot assess the safety concerns at the heart of the current controversy between two major freight carriers. The trucking industry is seeking further relaxation of federal truck size and weight regulations to improve productivity. The rail industry claims that further increases in truck size and weight would not only divert substan-

tial rail traffic, but would also degrade the safety of highway travel. The information needed to evaluate these positions—trend data on the safety of truck travel by truck type and road class—are simply not available.

- Transportation is a vital sector of the economy, accounting for 17 percent, or about $940 billion annually (in 1990 dollars), of total U.S. expenditures on goods and services. A major reason for making transportation investments is their contribution to economic growth, yet the link between spending for new transportation infrastructure and regional or national growth is poorly understood. Moreover, current measures of the productivity of the transportation sector do not reflect the full value of transportation services to the economy and long-term growth. Thus, the department cannot assess the ways and the extent to which alternative levels or types of investment can contribute to economic growth and international competitiveness.
- The transportation system must accommodate commercial and defense needs, as was demonstrated in the Persian Gulf War. However, systematic data on the use of the system, and the constraints created by the special requirements of military equipment, are not routinely collected. Thus, the secretary is unable to identify investment strategies that would have the greatest payoffs in improved military deployment capability or assess the consequences of military requirements on commercial transportation facilities and general economic performance.
- The Clean Air Act of 1990 requires that transportation projects conform with and contribute to plans for improving air quality in the nation's urban areas, requirements that could revolutionize the way that travel needs are met in large cities. However, the data to estimate emissions levels, such as information on vehicle travel and speeds, are inadequate, and the models used to forecast travel growth consistently underestimate demand, omitting key variables that affect propensity to travel. Without consistently gathered summary data on emissions for major urban areas, neither the Secretary of DOT nor the Administrator of the Environmental Protection Agency can assess the air quality impacts of alternative transportation investments or alternative levels of investment to meet federal reporting requirements.
- New technologies, such as high-speed rail, magnetically levitated (maglev) trains, and vertical take-off and landing aircraft, are being proposed as alternatives to airport and highway expansion in heavily traveled intercity corridors. However, with limited data on intercity surface passenger travel, the factors that influence modal trip choices,

and the costs of alternative modal investments, the department cannot evaluate the merits of alternative ways of meeting intercity travel demand or the implications for federal investment policies.

- Congestion has become a major concern of city and suburban dwellers in most large urban areas. However, without data on commuting delays or freight delivery times summarized and reported in a consistent manner across major urban areas, the department's ability to monitor demand across modes and determine whether solutions lie with new highways, more transit investment, demand management measures, or other alternatives is limited.
- Deregulation has resulted in loss of air, rail, and bus services for many rural communities. More complete data on the extent, frequency, and cost of providing transportation services in rural areas would strengthen the department's capacity to analyze rural service delivery alternatives and develop effective rural development strategies.

Providing an improved data capability to address these issues, even if all the information could be gathered, will not provide answers to all of these questions or guarantee better policies. In fact, more data may lengthen and increase the complexity of the decision process, but without good data, decisions will be arbitrary, options overlooked, and solutions reactive.

DATA SYSTEM REQUIREMENTS

The committee recommends that the department establish a national transportation performance monitoring system to track key indicators of the nation's transportation system and its environment. The system should be organized from the perspective of markets and users instead of individual transportation modes. NTPMS would provide a continuing source of trend data for monitoring the impacts of past policy decisions, an early alert system to anticipate problems and opportunities as they emerge, and a framework for more in-depth analyses of policy options and programmatic responses.

The source data for NTPMS should be organized according to the major attributes of the transportation system, which fall into four broad categories: (*a*) supply and (*b*) demand, which comprise basic information about the extent and capacity of the transportation system, activity levels and flows of passengers and freight, and characteristics of users;

(*c*) performance, which includes information on the value of the system to users, including its safety; accessibility; level, efficiency, and quality of service; and cost; and (*d*) impacts, by which the contributions of the system to other national goals, such as economic growth, national security, environmental quality, and energy conservation, are measured.

Analysis provides the means through which data are translated into useful information. Special studies to analyze key explanatory factors underlying trends, analytic models (e.g., for forecasting travel demand), and analytic tools, such as geographic information systems (GIS), which allow graphical display and analysis of spatially oriented modal data to enhance intermodal comparisons, must also be part of NTPMS.

The principal findings of NTPMS should be summarized in a congressionally mandated biennial report on the state of the nation's transportation system. This report would provide a regular assessment of the status of the transportation system, drawing on benchmark data from selected performance indicators organized by transportation markets.

Obtaining the data required for NTPMS would not involve supplanting existing modal data programs or amassing the detailed information on individuals and firms needed for economic regulation. Rather, it would draw on existing data or initiate data gathering that would complement existing data.

MEETING DATA REQUIREMENTS

Developing the data for NTPMS cannot be accomplished simply by combining existing modal data programs. It requires (*a*) collecting missing multimodal data and (*b*) linking extensive existing transportation data programs and supplementing them to improve data comparability for systemwide analysis.

The biggest current data gap from a multimodal perspective is passenger and freight flow data. These data not only provide basic system information on who and what is moving, by what mode, and from what origin to what destination, they are also critical input to other key system indicators of interest. Flow data provide the exposure measures to calculate accident rates per passenger-mile or ton-mile. Flow data are also critical inputs to forecasts of vehicle activity, which affects the level of congestion, vehicle emissions, and energy use. National surveys of passenger and freight flows should be the primary new data

collection activity for NTPMS. Although national level data will not provide the detailed information for some safety, environmental, and energy analyses, additional sampling in major transportation corridors and urban areas should provide adequate detail for national monitoring and analysis purposes.

Improving the comparability of existing data for analysis of system performance and impacts will require a long-term cooperative effort with existing data providers. Data on performance of the transportation system—the level of safety it offers, the extent of access it provides, and the service it delivers—are available for some modes. However, the coverage and comparability of these data are inadequate for making comparisons among the modes or drawing conclusions about the system as a whole.

Safety data warrant special attention because of the high priority the public and the department place on safety. Better exposure data, more consistent accident reporting thresholds, and more complete and consistent data on injuries for all modes are needed; obtaining these data will require a long-term cooperative effort among the DOT operating administrations and the states and other providers of accident data.

Personal mobility is a fundamental goal of transportation, but data on the availability, frequency, and cost of transportation services in rural areas and for low-income, elderly, and disabled populations are scattered among many agencies or are unavailable. Improving these data will require a joint effort among DOT, other federal agencies (e.g., the U.S. Department of Health and Human Services), and nonprofit organizations (e.g., Community Transportation Association of America) to integrate and amplify them.

Users are also concerned with the level of service provided by the transportation system. Several of the operating administrations (e.g., the Federal Highway Administration, Urban Mass Transportation Administration, Federal Aviation Administration) and the U.S. Army Corps of Engineers prepare reports on the condition and performance of modal systems, yet together, they do not provide an understandable and reliable basis for intermodal comparisons of the efficiency or quality of service or for assessing the performance of the system as a whole. Coverage should be expanded where possible to include more of the modes; more common measures of service quality and other indicators of performance should be introduced for each mode so that modal comparisons are possible; and measures of performance at intermodal connections should be devised.

Gathering data on how the transportation system affects other national policy objectives will require joint action with other federal agencies and, in some cases, other levels of government. Priority areas are those for which DOT has primary mission responsibility: measures for calculating the contribution of the transportation sector to economic growth (DOT, Bureau of Economic Analysis, and Bureau of Labor Statistics); condition and capacity of transportation networks essential to meeting national security needs (DOT and U.S. Department of Defense); impacts of transportation activity—vehicle emissions, wetlands intrusion, noise, oil spills—on environmental quality [DOT, Environmental Protection Agency (EPA), states]; and measures of energy efficiency to calculate the impact of the transportation sector on national energy dependency and global warming (DOT, EPA, and the U.S. Department of Energy). For many of these areas, measuring impacts is a first step; understanding what effect these impacts have on the economy or the environment is a far more difficult and poorly understood task.

The private sector has become an increasingly important source of transportation data with the decline in economic regulatory reporting requirements. DOT should purchase data from the private sector, or franchise data collection to private vendors, when such acquisition is more cost-effective, will not compromise the real or perceived credibility of the resulting information, and will not restrict public access to the final data products. Opportunities for cooperative public-private data-gathering efforts should also be examined.

Advances in data-gathering and information-processing technologies have the potential to reduce costs and reporting burdens while improving the speed and reliability of data collection and analysis. DOT should examine the areas of greatest opportunity for application in the development of NTPMS, such as automated surveying methods, electronic linking of records through electronic data interchange, automated vehicle and traffic monitoring through intelligent vehicle-highway system technologies, and integration of data into GIS for analysis.

ORGANIZATIONAL ISSUES

If the data and analytic capability for informed decision making on policies that are national in significance and systemwide in focus are to be available on a continuing basis, DOT must establish a permanent institutional structure within the department—a transportation data

center—to take responsibility for these tasks. The primary role of TDC would be to provide a focal point for the compilation and integration of systemwide transportation data and a key link among the operating administrations, other federal agencies and levels of government, and the private sector to ensure that these data are made available on a consistent, reliable, and continuing basis. Specifically, TDC would be responsible for developing NTPMS, managing the department's multimodal surveys, and preparing the biennial state of the system report.

Many federal agencies have developed and sustained broad data programs to support agency mission objectives by establishing central statistical offices, such as the National Center for Education Statistics, the National Center for Health Statistics, and the Energy Information Administration. Organization of TDC should be modeled on the best elements of other federal statistical agencies. These statistical agencies function as separate offices with permanent staff and separate budgets, command a strong measure of independence within their agencies to ensure the impartiality and credibility of the data they produce, and have a commitment to quality and professional standards.

Like many other federal statistical agencies, TDC would limit its new data collection activities to broad, cross-cutting data, such as the multimodal passenger and commodity flow surveys. Collection of data for operating and administrative purposes and mode-specific data acquisition should remain with the relevant operating administrations.

The specific functions of TDC should include identification of the data needed to develop NTPMS; data compilation, including electronically accessing summary data from existing modal data bases, supplementing modal data to improve comparability where necessary, and acquiring multimodal data (e.g., national surveys of passenger and freight flows); standard setting to improve the quality, consistency, and comparability of source data and quality assurance of its own data products; synthesis and interpretation of the data in a form useful for policy analysis; and dissemination of the data to the secretary, Congress, and the transportation user community.

Coordination and cooperation with numerous existing organizations are essential to the success of TDC. For example, development of NTPMS will require close cooperation with the operating administrations; the DOT Transportation Data Coordinating Committee could help examine ways to improve the linkages among existing modal data programs. The Offices of the Assistant Secretary for Policy and International Affairs and the new Office of Strategic Planning under the Assistant Secretary for Budget and Programs could assist in defining

the long-term strategic issues that are likely to shape the data collection requirements of TDC. The Volpe National Transportation Systems Center (VNTSC) of the Research and Special Programs Administration could assist in structuring the NTPMS; VNTSC has managed many of the department's modal data bases and currently has the primary responsibility for the limited multimodal data collection efforts of the department. In turn, TDC could provide support for many of these groups. With a permanent central data institution in place, the department should be better able to articulate its data deficiencies and build the case for obtaining the necessary resources to improve them.

Links also need to be forged outside DOT. The data responsibilities of TDC could help focus the agenda of the recently formed Federal Interagency Transportation Statistics Committee. The U.S. Bureau of the Census could assist with such activities as developing a TDC policy on confidentiality and data access, designing a user outreach and data dissemination program, and jointly sponsoring data collection programs. Finally, the private sector could help TDC define data requirements from a user perspective and become involved in collaborative data-gathering efforts.

NEXT STEPS

The immediate priority of the department should be establishment of TDC. This can be accomplished by executive action of the secretary; permanent authorization through legislation, however, should be achieved as soon as feasible. The first activity of TDC would be to assume responsibility for the national passenger and freight flow surveys, partial funding for which is included in DOT's fiscal year 1992 budget. TDC should ensure that continuing and adequate support of these surveys is provided. The committee recommends initial annual funding for TDC of about $20 million to support a director and core staff, the two national surveys, and start-up efforts to integrate existing transportation data and develop analytic tools.

In the short term, TDC should begin development of NTPMS, establishing an advisory committee of public and private users and providers of transportation data to ensure that the data requirements are structured from a user perspective. TDC should publish its first report on the state of the transportation system no more than a year after the center is established. Gaps in data should be highlighted and areas for strengthening data comparability pinpointed in the report preparation

process, providing a blueprint for future data gathering and analysis activities.

Over the longer term, TDC should broaden its activities: establish common definitions and survey standards to improve the consistency and comparability of existing data programs, working closely with the operating administrations and a technical advisory committee of experts in transportation statistics and analysis; develop memoranda of understanding with other federal agencies to set interagency data collection priorities and responsibilities; enter into joint ventures with the private sector in data collection efforts; promote the use of new information technologies; and develop a data dissemination program. These efforts will require sustained funding at a higher annual level than the initial $20 million.

DOT has an opportunity to bring together a broad constituent group through TDC to reverse long-standing criticisms of the inadequacies of transportation statistics. The timing is good. The Secretary of DOT has committed to developing a permanent strategic planning capability and has taken some initial steps to strengthen the department's data programs to support this effort. Congress has identified transportation data as an issue in the pending reauthorization of surface transportation legislation; the Senate bill would require establishment of a new Bureau of Transportation Statistics within DOT. The department must take advantage of these initiatives to create and sustain an institution dedicated to developing the knowledge base to inform policy makers about the strategic choices that will shape the transportation system of the future.

REFERENCE

Pub. L. 89-670. 1966. Department of Transportation Act. 80 Stat., pp. 931-950.

1

The Role of Data

In 1989 the U.S. Department of Transportation (DOT) embarked on a major strategic assessment of the U.S. transportation system to determine how best to meet the nation's future transportation needs (DOT 1989, foreword). The strategic planning process revealed significant deficiencies in the data needed to characterize the use and performance of the nation's transportation systems and support the evaluation of alternative policies and investment scenarios. The authors of the final policy document—A Statement of National Transportation Policy (NTP)—noted that multimodal assessments of the entire transportation system to support strategic planning "have not been regularly produced in a decade" (DOT 1990, 111, 112).

To remedy these deficiencies, the NTP called for action in two areas to improve the "coverage, quality, and availability of data" to support informed national transportation policy making: (*a*) a comprehensive assessment of data needs and priorities and (*b*) more effective and permanent institutional mechanisms within the department to improve coordination and management of these data (DOT 1990, 124). **Implicit in these recommendations is the recognition that building a permanent departmental planning capability that emphasizes strategic assessment, policy evaluation, and system monitoring is beyond the present capability of the transportation data system to deliver.**

SCOPE OF STUDY

To assist in the implementation of these recommendations, DOT requested that the Transportation Research Board (TRB) undertake a 15-month study of the availability and quality of national transportation data to support DOT's continuing strategic decision-making requirements. The study committee convened for this task

- Identified the data requirements and key elements of a data system to support national transportation policy making;
- Determined how these requirements could be met by modifying existing data programs, supplying missing data, collaborating with the private sector in data collection, and taking advantage of advances in information systems technologies to reduce the cost and burden of data collection;
- Examined institutional changes that are needed within DOT to improve the coordination and management of data collection to inform policy; and
- Recommended an implementation strategy.

The primary audience for the study is DOT; the main focus is data for national policy making. However, the department's mission is broad. The 1966 legislation through which the department was established (Pub.L. 89-670, 931) stressed its lead role "in the identification and solution of transportation problems . . . with full and appropriate consideration of the needs of the public, users, carriers, industry, labor, and the national defense." Moreover, the department depends on other federal agencies, state and local governments, and the private sector to collect and report much of the data. In addition, international exchanges of data are becoming increasingly important to addressing transportation problems in a global economy. Thus, developing data programs that will inform national policy making must involve all of these parties and should contribute to many of their policy needs.

OVERVIEW

Transportation affects our daily lives. It brings us goods and services, provides our means of getting to work, and meets our leisure travel needs. Each year the U.S. transportation system handles about 3.5 trillion passenger-miles and moves about 3.4 trillion ton-miles of freight[1] (DOT 1989, 1). During wartime, the system must also accommodate the rapid deployment of military personnel and equipment, as was demonstrated in the Persian Gulf War.

Transportation is a major sector of the economy, vital to economic growth. About 1 of every 6 dollars—$941 billion annually (in 1990 dollars), or 17 percent of the gross national product—is spent on purchases of transportation goods and services (Smith 1991, 6). These

purchases support slightly more than 10 percent of the U.S. work force in transportation or transportation-related jobs.

The mission of DOT is to develop and coordinate national transportation policies and programs that provide for the safe and efficient movement of goods and people, support economic growth, serve the national defense, provide for the general welfare, and contribute to such other national goals as resource conservation (Pub.L. 89-670). Most of the major modes of transport—highways, rail, public transit, air, water, pipeline, as well as emerging modes like commercial space transport—are represented under the DOT umbrella.[2] However, many of the issues that have a major influence on transportation policy today—national security and environmental, energy, and social concerns—require the department to interact with other national policy makers in the U.S. Department of Defense, the Environmental Protection Agency, the U.S. Department of Energy, and other federal agencies.

The Changing Transportation Policy Context

As the transportation system has grown and matured over the years, the policy issues facing DOT and related data needs have changed accordingly. The 1960s through the early 1970s was a period of building and expansion for many transportation modes. During this time, the majority of the Interstate highway system was constructed, major airports were built or expanded, and transit systems were rejuvenated and expanded with federal assistance. Not surprisingly, federal policies and related data programs were keyed to modal investment needs and financing requirements. The National Policy Studies of this period—the National Transportation Reports of 1972 and 1974—attempted to define public investment requirements for each transportation mode based on extensive surveys of the plans and priorities of state and local governments (DOT 1975, 3).[3] The last of its kind, the final report of the National Transportation Policy Study Commission published in 1979, attempted to forecast long-range passenger and freight travel and related modal capital investment requirements for two time periods and three growth scenarios (National Transportation Policy Study Commission 1979).

Near completion of large investment programs and the energy shocks of the mid- to late 1970s, which caused travel growth to slow, shifted policy concerns from system expansion to more efficient use of

the existing system and related strategies for system preservation and rehabilitation. Another major policy initiative at this time was deregulation of the aviation, interstate trucking, rail, maritime, and intercity bus industries. As the federal government shed responsibilities for economic regulation during the 1980s, related reporting requirements for carriers were also reduced. At the same time, such major data programs as the National Travel and the Commodity Transportation Surveys—the principal sources of information on intercity passenger and freight travel, respectively—were curtailed or discontinued, reflecting the prevailing political philosophy of a smaller government role in a deregulated environment.

Global markets and international trade grew rapidly during the 1980s, supported by corporations that plan, produce, and market on a global scale; containerization of cargo; and advanced communications technologies that are used to track and coordinate freight movements. The shift toward a borderless economy has had major implications for the way that transportation is conceived and used. Shipments have become increasingly intermodal as international brokers search for the most efficient combination of modes to move goods worldwide, from factory floor to distribution centers to final markets (Anderson 1990, 25; TRB 1992).

Increasing competition for global markets has also made firms more cost conscious. Firms are replacing costly large inventories with just-in-time delivery systems that rely on direct transport of production materials and finished products to manufacturers and distributors, respectively (Anderson 1990, 25). These changing patterns have put a premium on shipment reliability and timeliness and increased the costs to firms of congestion and delays in the transportation process (Johnston 1989, 26).

Finally, the shift from a predominately manufacturing to a service economy in the United States has placed new demands on the transportation system. Service businesses often require swift and reliable delivery of high-value products that need safe handling. The modes that provide these services, such as air freight, are favored despite their higher costs (Johnston 1989, 18). In essence, a two-tiered freight system has emerged in which large commodity shipments move on lower-cost bulk carriers, whereas high-value goods move on higher cost, demand-responsive air freight-truck combinations (Pisarski 1988, 31).

Globalization of the economy has also affected passenger transport. In 1989 receipts from foreign visitors to the United States exceeded

expenditures of U.S. travelers abroad for the first time (Frechtling 1990, A-13). Foreign airlines seek entry to U.S. domestic markets, and U.S. airlines seek reciprocal arrangements in foreign markets. Like shippers, passengers often base their travel choices on the most efficient combination of modes to minimize door-to-door travel time. As most travelers are well aware, it is total trip time, including the trip to and from the terminal and the time involved in transferring between modes, as well as the line-haul portion of the trip, that matters (Hopkins 1990, 16).

Developing transportation policies in this changing environment requires a clear vision of the role of transportation. Policy makers must be able to articulate the value of transportation to economic growth and society at large. At the same time, they must weigh other national objectives. Safety must not be compromised in the effort to meet ever-growing passenger and freight demand. The effect of expanding transportation capacity on urban air quality and reducing dependence on foreign oil must be considered. Policy makers must balance these objectives in developing investment policies and exploring alternative ways of accommodating users in adapting the system to changing needs.

Implications for Data

The changing transportation environment has important implications for data. The supply-oriented perspective and mode-based data programs that dominated the earlier construction era were appropriate for the modal investment and financing policy issues of that time. **A strictly modal approach is insufficient to address the issues that face the transportation system of the 1990s and beyond;** issues that involve trade-offs among the modes, intermodal linkages, or broader national objectives are at the heart of most strategic policy choices facing the department. **Today's more market-focused environment requires a demand-oriented perspective and data programs that provide policy makers with information about the performance of the system and its contribution to other national goals.**

The organization of data activities at DOT is not conducive to providing this kind of information. The data programs in the department have been developed largely to serve the missions and policies of the operating administrations and the related concerns of mode-oriented audiences, such as congressional oversight commit-

tees. In this decentralized environment, the data are not structured to address broad policy questions that cut across specific modes. A good case in point is the reports provided by many of the operating administrations on the condition and performance of individual modes. Because these reports are tailored for different audiences with different interests and produced at different times, they share little in the way of common frameworks or assumptions about travel demand and economic forecasts or definitions of need and performance. Thus, the data they provide are difficult to use in any consistent way to compare the modes and assess the performance of the system as a whole.

Not only are transportation data decentralized and modally oriented, but modal responsibilities and missions vary widely, affecting the breadth of the data collected. Responsibilities range from those of the Federal Aviation Administration, which owns and operates a major sector of the aviation infrastructure, the air traffic control system, to those of the Federal Railroad Administration, which is responsible for regulating the safety of the rail system, whose ownership and operation reside largely in the private sector. Deregulation has further narrowed federal responsibilities and shifted regulatory authority from economic to safety and environmental areas. However, because departmental regulatory and investment policies continue to affect the ability of private carriers to provide service, DOT policy makers need summary data on the quality and efficiency of service offered by major modal service providers to monitor the impacts of federal policies on performance of the transportation system. In sum, with differing responsibilities for operating and regulating transportation modes, individual operating administrations have differing needs for and access to data that result in a less-than-complete national picture of the transportation system.

Recreating the data collection programs of a regulated transportation environment, however, is not the answer. The detailed reporting requirements that supported industry economic regulation would not only be costly to collect and burdensome to data providers, but would be inappropriate for the broad strategic policy needs of the secretary. Although some multimodal data are missing, a wealth of information about transportation modes and services is available. **What is lacking is a systemwide framework and capacity to integrate and compare data on a more consistent basis over time to track system performance and determine where the transportation system is headed.**

ROLE OF DATA IN THE POLICY PROCESS

In today's complex, rapidly changing environment, the Secretary of Transportation, as chief adviser to the President and advocate before the Congress on national transportation policies, must have the capability to anticipate problems and devise policies to shape the transportation system of the future. This role requires strategic thinking, data to track performance, and analysis to convert data to information useful for policy. Corporate managers of many large U.S. companies have developed the strategic planning capability as well as the data and analytic support systems to assess the business environment and devise appropriate strategies to maintain their competitive edge (Bryson 1989, 1,2). **The manager of a $30 billion public agency (Executive Office of the President 1991, Part Four, 144), whose decisions affect one-sixth of total U.S. expenditures on goods and services, should have the same capability.**

Many strategic issues face the secretary today, yet the ability to address them is limited by lack of data or data that are poorly formulated to inform policy choices. Data alone cannot guarantee good policy, but informed policy choices are not possible without good data, as the following examples illustrate.

- Safety was identified in the NTP as a top departmental priority (DOT 1990, 7), yet the secretary cannot address the safety concerns that are at the heart of the controversy between the trucking and rail industries. The trucking industry is seeking further relaxation of federal size and weight regulations, which it claims will improve productivity without adversely affecting highway safety. The rail industry has challenged this position, arguing that allowing longer and heavier trucks would not only lead to disinvestment and even abandonment of rail infrastructure, but would also degrade the safety of highway travel; thus, trucking productivity gains would be achieved at a great cost to the traveling public. The information needed to evaluate these positions—trend data on the safety of truck travel by truck type and road class—are simply not available (TRB 1990, 2).
- A major reason for transportation investments is their contribution to economic growth, yet the link between spending for new transportation infrastructure and regional or national economic growth is poorly understood. Without detailed information on the availability, cost, and quality of transportation services and how they affect productivity and long-term growth, it is difficult to quantify how new transportation

facilities can contribute to economic growth and international competitiveness, or to compare the impacts of alternative investments.

- The transportation system must accommodate both commercial and defense needs. Fortunately, when the system was tested by the Persian Gulf War, defense transportation needs could be accommodated from the slack in commercial demand from an economy in recession without major disruption to economic activity. Systematic data on the use of the system, including transfer points, and the constraints created by the special requirements of defense equipment, however, are not routinely collected. Thus, the secretary is unable to identify where added investment in facilities would have the greatest payoffs in improved military deployment capability or assess the consequences of military requirements on commercial transportation facilities and economic performance.
- The Clean Air Act of 1990 (Pub.L. 101-549) stipulates that transportation investments conform with and contribute to measures to improve air quality—a requirement that could revolutionize the way that travel needs are met in the nation's urban areas. Compliance with the act requires assessments of projected emissions from proposed transportation improvements in heavily polluted areas. However, neither the Secretary of Transportation nor the Administrator of the Environmental Protection Agency has sufficient data on the factors that affect emissions levels, such as vehicle travel and speeds in urban areas, to estimate likely emissions impacts from alternative levels of investment, nor are the factors affecting travel demand sufficiently well understood to develop adequate models and forecasts of likely growth in travel.
- New technologies are being proposed to alleviate congestion in heavily traveled intercity corridors. High-speed rail or magnetically levitated (maglev) trains, vertical take-off and landing aircraft, and other systems have been suggested as alternatives to sometimes unpopular and frequently prohibitively expensive airport expansions and road-building programs. However, limited information on intercity surface passenger travel, factors that influence modal trip choices, and costs of alternative modal investments hamper departmental ability to evaluate the relative merits of alternative ways of meeting intercity travel demand and the implications for federal investment policies.
- The proliferation of automobiles in large urban areas has created severe congestion near suburban as well as inner city job concentra-

tions. However, comprehensive data on commuting delays or freight delivery times, consistently collected, summarized, and reported for major urban areas, are lacking. Without data on travel patterns, it is difficult to monitor demand across modes and determine with any certainty whether solutions lie with new highways, more transit investment, demand management measures, or other alternatives.

- Deregulation has resulted in reduced access to transportation facilities for many travelers from rural communities because of loss of air, rail, or bus services. Data on the extent, frequency, and cost of transportation services in rural areas are scattered among many sources or are unavailable. More complete data would strengthen the department's capacity to analyze rural service delivery options and devise appropriate rural investment policies.

As these examples illustrate, the secretary lacks information to analyze and address fundamental questions on the costs, benefits, and impacts of alternative transportation policies that affect a wide range of regulatory and investment decisions. Not all of these data can be gathered or questions answered, but a more sustained effort to develop the knowledge base is warranted, given the broad impact of transportation decisions.

In recent years, the department has chosen to organize its data collection and analysis activities to support national policy making on an ad hoc basis, conducting periodic or one-time national transportation studies or simply not conducting any national assessments. Periodic studies can provide a snapshot of the critical issues facing the transportation system at a particular point in time. However, relying on periodic studies alone to provide data for policy making is costly and shortsighted; one-time studies frequently require special surveys and development of analytic tools whose useful life only extends for the duration of the study. In addition, they provide little in the way of trend data to suggest how well the system is performing over time. These data are critical for determining how well current policies are working, providing an early alert of changes in the environment and emerging problems that may require modifications in policies or new policies altogether and for assessing how well the system reacts to shocks, such as the energy crises of the 1970s or the Persian Gulf War. Finally, the lead time involved in producing a major national study and the lag between studies mean that data are often not available when they are

needed, that is, when a policy issue arises and a response is required. **This arrangement is a major liability in a rapidly changing environment. An on-going data capability to support national transportation policy making is needed.**

ORGANIZATION OF REPORT

Examined in the remainder of the report is how this on-going data capability can be developed within DOT. The key elements of a data support system are identified in Chapter 2. Chapter 3 is focused on how these requirements can be met by improving existing data bases and supplying missing data; opportunities for public-private collaboration in data collection are considered, and applications of new technologies for reducing the cost and burden of data collection are explored. The institutional changes needed to develop a more effective and permanent data and analytic capability to support strategic decision making within the department are discussed in Chapter 4, and a new organization is recommended. The steps required to put such a capability in place are outlined in Chapter 5.

The time to move forward on these recommendations is now. Recent DOT strategic planning provided opportunities for operating administrators to exchange ideas on issues that transcend modal boundaries. The Secretary of Transportation has committed to establishing an ongoing strategic planning capability (DOT 1990, 11) and has taken steps to formalize interdepartmental and interagency linkages. In addition, Congress has focused on transportation data in pending surface transportation legislation. These initiatives, which are described in more detail in the following chapters, should provide the support to develop a more policy responsive transportation data system and analytic capability.

NOTES

1. Passenger-miles are a measure of the volume of people carried multiplied by the distance they are carried. Similarly, ton-miles are a measure of the volume of product carried multiplied by the distance it is carried.
2. Exceptions are ports and inland waterways, for which the U.S. Army Corps of Engineers is responsible.
3. The report, *National Transportation: Trends and Choices*, DOT's first multimodal national transportation planning effort, which was published in 1977, attempted to take more of a systems' perspective, examining likely transpor-

tation service trends under then current policies and highlighting the choices likely to face national policy makers (DOT 1977, iv, v).

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DOT	U.S. Department of Transportation
TRB	Transportation Research Board

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2

Data Requirements: A National Transportation Performance Monitoring System

The Statement of National Transportation Policy (NTP) represents the first step in building a more forward-looking, strategically oriented, multimodal approach to national transportation decision making at the U.S. Department of Transportation (DOT) (DOT 1990, 11). The broad policy goals and directions that should guide future national transportation policy decisions are outlined in the NTP. Currently, the department is engaged in the second phase of the strategic planning process (Figure 2-1), which involves implementing these broad policy goals through regulatory changes, new legislation, and resource allocation.

In the long run, development of a continuing capability to take stock of the performance of the transportation system—to assess how well the department is performing its mission and to identify emerging issues—will require ongoing monitoring and evaluation in order to analyze and adapt policies to changing conditions. This, in turn, requires the collection, organization, and analysis of data in a framework suitable for policy analysis and decision making, which is currently not available. **The committee recommends that the department develop this capability by creating a national transportation performance monitoring system (NTPMS) to track key indicators of the nation's transportation system and its environment over time** (see shaded areas of Figure 2-1). NTPMS would be organized by markets to monitor performance from the perspective of users of the transportation system—passengers and shippers. The key elements of NTPMS

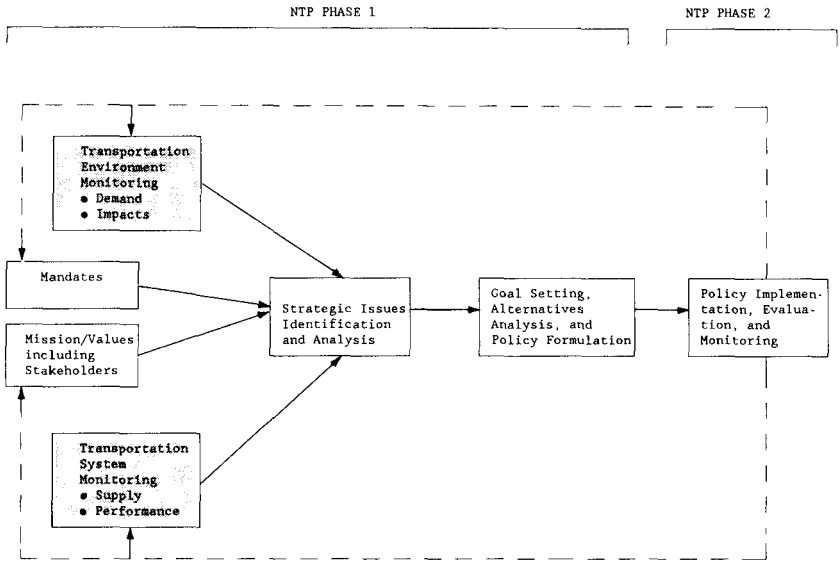

FIGURE 2-1 Overview of the strategic transportation planning process.

are identified in this chapter. Although the immediate beneficiaries of NTPMS would be policy makers, the recommended reorientation of national data toward users and markets would also benefit researchers and others seeking to understand how transportation markets work.

STRATEGIC PLANNING CONTEXT

Concerns about the adequacy of transportation data for national policy purposes were raised during recent strategic planning at DOT. The strategic planning process is used here as an organizing device for identifying data requirements; however, the data requirements would be the same for any general performance monitoring system to support national policy making.

Strategic planning has been defined as a "disciplined effort to produce fundamental decisions and actions that shape and guide what an organization is, what it does, and why it does it" (Bryson 1989, 5). The process is distinctive in its focus on issues, its emphasis on the context or environment in which an organization operates, and its action orientation (Bryson 1989, 7, 8).[1]

Suggested in the NTP are the types of policy issues that a performance monitoring system should address. **Strategic planning is geared to identifying and resolving issues that are national in significance, systemwide in focus, and long-term in view.** Strategic issues imply major changes in, or potential impacts on, the system, such as the following:

- Major changes in the environment (e.g., demographic changes), or in policies that affect the environment (e.g., energy policy), in which transportation operates;
- Fundamental shifts in transportation policy or DOT's role in the transportation system (e.g., deregulation);
- Large investments or changes in the allocation of resources, which have the potential for substantial improvement or degradation in system performance (e.g., a major increase or reduction in federal funding for surface transportation);
- Major changes that alter the structure and delivery of transportation services (e.g., just-in-time delivery systems, double-stack container trains, or electronic data interchange); and
- Major system impacts that extend beyond transportation and affect other national interests (e.g., national security or environmental quality).

The Clean Air Act of 1990, for example, may revolutionize the way that travel needs are met in some urban areas, such as Los Angeles, where complying with air quality standards may require that a significant share of passenger trips be made by public transportation, high-occupancy vehicles, and vehicles powered by alternative fuels. Such major changes in the delivery of transportation services raise broad policy issues that involve more than one mode and have potentially large impacts on the economy and on the quality of life.

NTPMS would provide analysts and policy makers with input to address fundamental questions, such as those presented in the accompanying text box, on a continuing basis. It would not, however, ensure the answers to these questions or the availability and collection of all of the data needed to address them. **The primary purpose of NTPMS would be to provide policy makers with a monitoring capability.** Baseline data would be regularly available on a systematic basis to track the overall performance of the transportation system, monitor the trends and forces in the external environment that could affect the

ILLUSTRATIVE NATIONAL TRANSPORTATION POLICY QUESTIONS

- What are the geographical and temporal patterns of transportation demand?

  -What kinds of goods are moved? How much is moved? What are their origins and destinations? When and how are they moved?

  -What types of people travel? How many travel? What are their origins and destinations? When and how do they travel?

- How are changes in demographics, lifestyles, economic conditions, and business activity likely to affect future geographical and temporal patterns of transportation demand?
- Does the current transportation system have the capacity, coverage, and flexibility to serve current patterns of transportation demand? Who or what is left behind?
- Will the transportation system have the capacity, coverage, and flexibility to accommodate anticipated changes in demand? Who or what will be left behind?
- How safe, costly, timely, frequent, and reliable is the current transportation system for travelers and shippers?
- How are anticipated changes in demand likely to affect the safety, cost, efficiency, frequency, and reliability of transportation services in the future?
- What is the responsiveness of demand to changes in the price, reliability, or frequency of transportation services and what is the responsiveness of supply to different increments of cost?
- How does the current transportation system support or degrade other national objectives, such as environmental quality, energy self-sufficiency, economic growth, national security, and social well-being? How do these other objectives affect the transportation system?
- How are anticipated changes in the demand for transportation services likely to affect the achievement of other national objectives in the future, and what conflicts are likely in attempts to meet these goals simultaneously (e.g., more fuel-efficient vehicles could mean reduced highway safety; improved safety could be achieved through greater restrictions on mobility)?

system's ability to perform, and measure the impacts of the system on this external environment.

Second, NTPMS would provide an early alert to problems and issues as they emerge. It would help policy makers identify potential opportunities for improving transportation system performance by confirming problems that have been identified by special studies or by concerned carriers or customers.

Finally, it would provide a framework and point of departure for those engaged in formulating policy alternatives and evaluating the likely consequences of policy responses to strategic issues. NTPMS would be policy neutral. Its purpose would be to shape data in ways that are analytically useful and provide a context for evaluating the effectiveness of specific DOT policies and programs.

NTPMS would supplement but not supplant existing data programs. It would draw heavily on these data where possible, integrating them to provide an overview of the performance of the transportation system as a whole from the viewpoint of markets and users and to illuminate intermodal comparisons. **Its focus would be on the performance of the transportation system instead of the performance of individual modes or specific programs.**

ELEMENTS OF NTPMS

An effective data support system has two essential components. First, the data should be organized in a framework keyed to the broad subject areas of interest. Second, analytic capability is critical to ensure that the data are translated into information that is useful for policy analysis. The latter is particularly important for understanding qualitative changes that are not readily measured or, if they do appear in time series data, are reflected too late for policy makers to take action (Drucker 1990, 78).

Data Organization

The time and cost of collecting and integrating data, as well as the need for systematic and reliable monitoring over time, work against constant modification of data bases. Thus, **NTPMS is best structured not by issues, which tend to be transient, but by major attributes of the transportation system, which fall into four broad categories—supply, demand, performance, and impacts** (Figure 2-2).

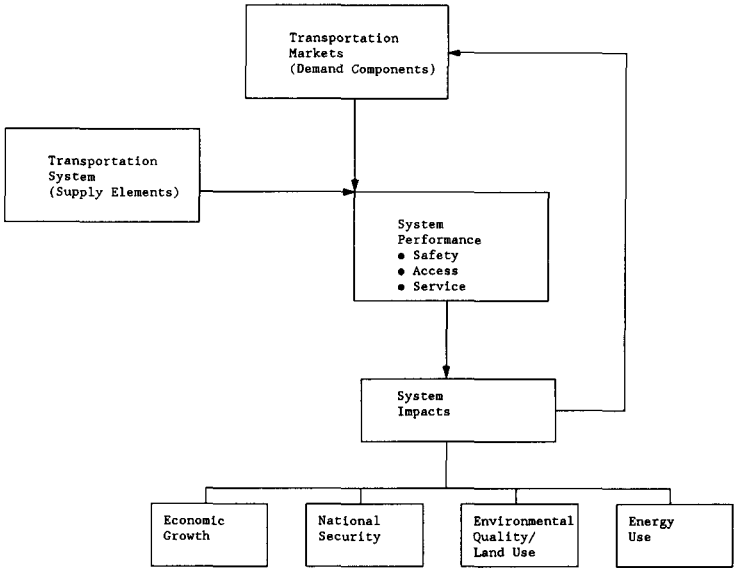

FIGURE 2-2 Structure of data system to support strategic transportation decision making.

These categories may be further defined by a set of descriptive elements (see accompanying text box).

The supply and demand attributes include the basic descriptors of the transportation infrastructure, its service providers, and its users. The supply side contains information on system resources and outputs, including the characteristics, coverage, physical condition, capacity, and fare or fee structure of the transportation system and subsystems, along with the characteristics and financial condition of the major transportation service providers. The demand side is focused on system needs created by the activity levels of passengers and freight, the distribution of these activity levels, and the characteristics of passenger and freight users. Information about who or what is moving or being moved, for what purpose, and between what points in the system is basic input for nearly every policy issue.

The performance and impacts attributes provide a description of how the system functions and with what effect. The delivery of service by the transportation system is the product of the interaction of requirements on the system (i.e., demand elements) with system capacity and condition (i.e., supply elements) (Figure 2-2). System performance is

NTPMS DATA ATTRIBUTES AND DESCRIPTORS

Supply

System

- General characteristics,
- Coverage,
- Physical condition,
- Capacity,
- Fare or fee structure, and
- Elasticity of supply.

Providers

- General characteristics and
- Financial condition.

Demand

- User characteristics,
- Activity levels,
- Flows, and
- Elasticity of demand.

Performance

- Safety and personal security;
- Access and mobility;
- Service delivery:
  - -Level,
  - -Efficiency, and
  - -Quality; and
- Cost.

Impacts

- Economic growth,
- National security,
- Environmental quality and land use, and
- Energy use.

measured by such factors as the safety of transportation services; the access and mobility they provide; the level, efficiency, and quality of service they offer; and their cost. The transportation system functions in and affects a broader environment. Measures of the impact of transportation on economic growth, national security, environmental quality and land use, and energy use are also of interest, as well as the impacts of these external forces on the demand for and nature of transportation services.

Benchmark data should be developed for each system attribute by identifying and tracking key indicators for each data descriptor. In most cases, a single indicator is not sufficient; portraying an accurate picture of the trend would require several indicators. For example, information about numbers of transportation fatalities or accidents can be misleading if additional information is not provided on the level of activity or exposure. Measures of the variability and the mean level of operation are also important, particularly for service delivery characteristics; shippers and travelers often care more about the predictability of transit time than the absolute time in transit. Finally, comparisons with other industries for selected benchmarks, such as safety levels, productivity growth, and cost, and with general measures of economic activity should help provide perspectives on the role of the transportation sector in the economy. In some cases, the desired system attribute may be too complex to be captured adequately even by several indicators. For example, although the design capacity of a transportation facility can be measured, estimating its operational capacity requires making assumptions about the availability of alternative routes or modes, use of operational strategies (e.g., congestion pricing) to spread demand, and "acceptable" levels of congestion—assumptions that cannot readily be captured in summary indicators. Indicators that could be used to measure the basic data attributes and descriptors of the transportation system are presented in Table 2-1. The final selection of indicators is beyond the scope of this report; however, this is an important task that must be undertaken as an integral part of developing NTPMS.

Market Focus

Structuring data to provide useful information for national policy making requires a decision about the appropriate organizing unit for data collection. Traditionally, transportation and related data programs have been divided into particular modes, such as highways, air, and

TABLE 2-1 TRANSPORTATION SYSTEM INDICATORS

Data Attribute and Descriptor	Indicators
Supply	
System	
General characteristics	Inventory information (e.g., miles of system)
Coverage	Unit of system per land area or population
Physical condition	Index of condition (e.g., pavement serviceability rating)
	Age of facilities
	Maintenance expenditures per unit of system
Capacity	Vehicles/persons per hour, tons per hour
Fare or fee structure	Range of prices, prices per passenger-mile/ton-mile, price/service options
Elasticity of supply	Percent change in supply relative to a one percent change in cost
Providers	
General characteristics	Number and size of public providers/common carriers/private carriers and providers
Financial condition	Balance sheet and income statement data
Demand	
User characteristics	
Passenger	National demographic and economic data (e.g., age, sex, income, etc.)
Freight	Bulk, density, shipment sizes, containerization, hazardous contents
Activity levels	Traffic counts, volumes, arrivals/departures
Flows	Origin-final destination volumes by trip purpose, distance, mode, passenger and freight characteristics
Elasticity of demand	Percent change in demand relative to a one percent change in price or other measurable attributes of service quality
Performance	
Safety and personal security	Total number of accidents, deaths, and injuries, by market
	Number of accidents, deaths, and injuries per mile and per capita, by market
	Percent of accidents by severity level, by market
	Number and type of security incidents, by service population, by mode
Access	Share of population and households living within defined distances and travel times from airports and for scheduled surface transportation
	Percent of system facilities and services handicapped accessible

TABLE 2-1 *(continued on next page)*

TABLE 2-1 *(continued)*

Data Attribute and Descriptor	Indicators
Level	Frequency (e.g., runs per hour/day), average wait time, headways
	Number of transfers per commuter or freight shipment relative to average trip/shipment length
Efficiency	Load factors per unit of capacity available, by market and mode
Quality	Percent on-time performance, average delay time, by market
	Percent service interruptions and cancellations, by market
	Value of goods damaged in transit
	Value of inventory in transit (average day)
Cost	Cost per trip and unit of travel
Impacts	
Economic growth	Average days in inventory held by industry
	Distribution costs as percent of domestic retail prices/landed export prices
	Tourism receipts, domestic and international trips
National security	Condition and capacity of commercial transportation facilities and special military transport requirements in defense-essential corridors
	Percent of defense-essential facilities above capacity limits
Environmental quality/ land use	Vehicle emissions levels in nonattainment areas
	Tons of greenhouse gas emissions from transportation sector
	Acres of wetlands affected by construction of transportation facilities
	Number of incidents and extent of spills from transport carriage on waterways
Energy use	Energy use by appropriate energy measure per mile of travel, by market

rail. This view of the system has led policy makers to emphasize modal solutions to problems (DOT 1989, 12) and focus on individual components of the system instead of systemwide impacts.

Organizing NTPMS around markets should provide a more useful framework for analyzing strategic issues, which cut across modes, and involve intermodal comparisons. The primary emphasis would be on the transportation needs of particular markets and on how well modes are serving these markets instead of on the

performance of individual modes. For example, by examining the transportation needs of domestic intercity travel markets, policy makers might find that performance could best be improved by upgrading weak links between modes (e.g., improving highway or transit connections to airports) or providing a new mode of transportation altogether (e.g., high-speed rail). These solutions are unlikely to emerge from a traditional modal approach, which would concentrate on the performance of intercity trips by individual modes—air, automobile, bus, or rail.

An Illustration

An example serves to illustrate how a market-focused data system would work to inform policy makers about strategic issues. A key concern of shippers today is how to improve the efficiency of domestic intercity freight transportation to compete effectively in world markets. As a major provider of much of the infrastructure on which freight is carried (i.e., highways, waterways, and airports and airways) and regulator of the safety of freight transport, the public sector plays a major role in shaping the direction of future freight activities.

DOT policy makers seek answers to the following questions. To what extent have the reliability and timeliness of freight shipments been adversely affected by growing highway congestion and the increasing difficulty of expanding highway capacity? How do federal policies, such as truck size and weight regulations, affect modal choices and thus the financial health and competitiveness of competing modes, such as railroads or intermodal transport (e.g., trailer-on-flatcars, double-stack container trains)? What effects do these policies have on the overall safety of freight transport, and what are their long-term impacts on national security, the environment, and energy use?

These issues are better addressed by an approach that is market, not mode, driven. The key question from a policy perspective is which combination(s) of federal regulatory and investment strategies will provide the greatest improvement in the efficiency of goods movement without compromising safety or significantly degrading other national objectives, such as environmental quality. What information could NTPMS bring to bear on this question?

Comparative data could be gathered on the current performance of freight transport by alternative modes and combinations of modes by regions and major markets. With information on market access

to different transportation modes, the safety of these modes, and the quality of the service they provide, policy makers should be in a better position to identify appropriate modal regulatory and investment options, assess their likely consequences on modal shifts and demand for transportation services generally, and examine their impacts on other national objectives (e.g., national security implications of service elimination or abandonment of substantial portions of existing network facilities, degradation of urban air quality and increased energy use from a significant expansion in freight traffic). Data on the safety performance, energy use, and pollution effects of individual transport modes have not been brought together in a comparable way or at a level of geographic detail that is useful to policy makers in assessing the trade-offs between efficient goods movement and other national goals from shifts in traffic among modes.

Data on freight flows and the condition and capacity of alternative transport modes, organized by market area and intercity corridor, are essential for these analyses. [These data could be drawn in part from sample surveys of firms (i.e., flow data will be gathered in this manner from the planned Commodity Flow Survey) and in part from existing surveys of modal facilities (i.e., many of the operating administrations currently report on the condition and capacity of modal facilities and services).] Properly analyzed data on freight flows and the distribution of these flows by mode between origin and final destination should help identify heavily used intercity travel corridors and intermodal transfer points as well as provide comparative data on the intensity of use for different modes. When flow data are combined with supply-side data on modal condition and capacity, policy makers should be able to pinpoint more precisely where congestion is or is soon likely to become a problem and what modal options are available and are likely to remain so in the foreseeable future for accommodating growth in demand. Currently, freight flow data by origin to final destination are not collected, nor are supply data tracked by market area or corridor. Thus, little national information exists on the location and severity of transportation capacity constraints, types of shipments affected, modes involved, availability of alternative modes, and appropriateness of these alternatives given the volume of commercial freight or military shipments and their characteristics. These data, summarized by major market areas and selected intercity corridors, are essential to provide DOT with baseline information on the use and condition of alternative transport modes for monitoring the impacts of existing federal invest-

ment and regulatory policies and evaluating the likely outcomes of proposed policy changes.

Data Sources, Coverage, and Comprehensiveness

The primary sources for NTPMS are data collected directly from business establishments and individuals [through surveys of company executives and heads of households (i.e., the reporting units)] and data drawn from administrative records and other surveys (e.g., traffic surveys). The data can comprise a census (e.g., a count of all fatal highway crashes contained in the *Fatal Accident Reporting System* of the National Highway Traffic Safety Administration) or they can represent a sample (e.g., of individuals or firms, the sampling unit for surveys, or of records, such as rail waybills, airline tickets, or other appropriate sampling units for administrative data).

NTPMS should draw on both kinds of data. However, two issues are likely to arise in determining how best to collect the data for national monitoring purposes—the adequacy of sample versus census data and the appropriate level of aggregation of the data.

In general, sample data, rather than the detailed reporting by individuals and firms typical of regulatory data or complete enumeration of administrative records, are likely to be adequate for monitoring purposes (TRB 1990, 11). The difficulty is ensuring that the data are representative and comparable, because they are frequently collected from multiple sources that are aggregated for national summaries. In those areas for which DOT has regulatory responsibility—safety, environmental impacts of transportation investments, and fuel efficiency of motor vehicles, large sample sizes may be necessary to provide the level of detail needed to monitor the impacts of regulatory policies.

A related issue is the appropriate level of aggregation of the data for monitoring and analysis of national policy issues. **Given the proposed market focus of NTPMS, data that are aggregated by regions, market areas, and major corridors are likely to be more relevant than data summarized by traditional jurisdictional boundaries. The level of aggregation will also depend on the nature of the issue.** For example, surface transportation congestion and poor air quality are largely urban phenomena, the impacts of which are best analyzed at the urban level, whereas data on passenger and freight movements, which provide information about the use of the transportation system,

are probably adequately summarized at the regional and national level. **Finding an appropriate balance of data that are highly aggregated yet sufficiently detailed for national monitoring and policy-making purposes is an important challenge in the development of NTPMS.**

Frequency of Data Collection

The data should be collected on a continuing basis to provide the time series needed for long-term monitoring and problem identification. However, not all of the data need to be collected annually. Data on passenger and commodity flows and characteristics, which are expensive to collect and unlikely to change dramatically from one year to the next, could be collected periodically. Data on safety, energy use, and the environment, however, which are important areas of regulatory concern for DOT, probably should be collected more frequently.

Timely reporting of the data, particularly for data that are only collected periodically, is crucial. The usefulness of NTPMS as an early warning system for strategic analysis is only as good as the currency of the data provided.

Data Analysis

Data collection alone would provide an inadequate information system for national policy making. Analysis is needed at several levels to translate data into useful information for policy makers.

At a minimum, a brief description of the data items, their sources, and methods of collection should be provided. A summary of key trends and changes in trends would also be appropriate, as would a discussion of the quality and limits of the data. The rationale for the choice of indicators should be made explicit and the findings summarized. Finally, important topics, which are not amenable to measurement, should be identified and discussed qualitatively.

Proper interpretation of trend data, however, requires special studies to analyze the key explanatory factors underlying the trends. For example, user surveys could supplement and help explain data on performance. Special analyses of the main factors driving the growth in freight and passenger demand could improve understanding of flow data. [A special Transportation Research Board planning group on strategic issues in domestic freight transportation ranked a study of the characteristics and growth of freight demand as one of its top

priorities (TRB 1991).] Periodic special studies may also affect the data collection process itself by suggesting new topics that should be monitored and others that may be discontinued.

Trend data are also likely to prove inadequate as a means of alerting policy makers to emerging changes in the environment in which transportation operates. Special studies may be required, drawing on data primarily collected by others (e.g., Bureau of the Census, Bureau of Labor Statistics, and industry associations) to assess the likely impact of fundamental changes in demographics, regional growth, employment patterns, technology, and logistics practices on the future demand for and use of transportation services.

In addition, a common set of assumptions for forecasting transportation activity levels is needed. Currently, the department does not have a very cohesive view of the future; each of the operating administrations does its own forecasting, often using different assumptions about demographics, employment levels, labor force characteristics, and, perhaps most important, economic growth rates and related assumptions about inflation rates, interest rates, and growth in gross national product. At a minimum, an appropriate set of common economic assumptions should be defined (the Council of Economic Advisors, the Congressional Budget Office, and private firms such as Data Resources, Inc. provide economic forecasting data) for use by the operating administrations in developing modal forecasts. Alternatively, baseline forecasts could be prepared centrally for passenger and freight travel demand, which could then be used as input by policy makers in examining the systemwide impacts of different modal policy options.

Modeling capability should also be developed. For example, analytic models could be prepared, on the basis of knowledge of the key factors affecting travel demand, to assist policy makers in more sophisticated analyses of "what if" propositions in projecting the likely impacts of different assumptions about travel growth. Models could also be developed to help analyze the impacts of projected changes in the demand or supply of transportation services on systemwide performance.

Geographic information systems (GIS) offer another analytic tool for integrating and manipulating data for intermodal comparisons and analyses of system impacts, which should be further developed for transportation policy applications.[2] GIS are computer-based systems that organize and display spatially oriented data by linking locational and attribute data and overlaying them on a map

(Dueker 1990, 20). Transportation facilities and flows, because of their inherent geographic character, are particularly amenable to GIS applications. Current applications include optimal routing of hazardous materials and deployment of military equipment, analysis of highways for inclusion in the proposed National Highway System, and determination of the adequacy of transportation infrastructure and services in rural areas. DOT is currently the lead agency for coordination of spatial transportation data on the Federal Geographic Data Committee and supports development of a national transportation network data base as the core of a multimodal GIS capability.[3] These efforts should be expedited as part of the development of NTPMS.

BIENNIAL PERFORMANCE REPORT

A major product of NTPMS should be a mandated biennial report on the state of the nation's transportation system. This report should provide an overview of system performance and impacts, summarizing benchmark data from selected indicators.[4] It should provide a continuing source of baseline information on the conditions and trends of the transportation sector for policy makers, research analysts, and system users both within and outside DOT. (Data could be provided to users in a machine-readable form.) It should focus on the performance and contribution of transportation to the economy and society and monitor how they are changing over time.

Preparation of this report would require a collaborative effort with the operating administrations, other federal agencies, and the private sector. The process of preparing the report should help define missing data and areas in which comparative data from the modes need to be strengthened. The potential visibility and wide distribution of this report could help develop broad-based support for an enhanced transportation data collection and analysis effort.

The closest approximations to such a report are the annual *National Transportation Statistics*, prepared by the Volpe National Transportation Systems Center of the Research and Special Programs Administration of DOT, and *Transportation in America*, currently funded by the Eno Foundation for Transportation. Compiled in the former report are inventory, financial, performance, and safety data from a wide range of sources for all transportation modes, as well as supplementary data on the transportation sector's contribution to the economy and its con-

sumption of energy resources. Budget constraints, however, limit the value of the report as an adequate source of multimodal data for strategic policy making.[5] For example, performance data are focused on readily available indicators, which do not include measures of service quality. No attempt is made to examine the comparability of the data that are reported, point out their limitations, or summarize the key facts that can be drawn from the data. The latter report also draws trend data from a wide range of sources to provide an overview of the transportation sector, but provides little interpretation of the data or discussion of their limitations.

FINDINGS AND RECOMMENDATIONS

Development of a more strategically oriented, multimodal approach to national policy making at DOT requires a strong data support system, which does not currently exist. Trend data should be gathered at DOT on an ongoing basis to track key indicators of the performance of the transportation system, and the analytic capability to convert these data into information useful for policy should be developed and sustained. The committee recommends the development and implementation of a national transportation performance monitoring system as the most appropriate vehicle to meet this objective. It recognizes that this task will not be easy nor will it guarantee better decisions, but without good data, decisions will be arbitrary, options overlooked, and solutions reactive.

The data are best structured in a framework that mirrors the key attributes—supply, demand, performance, and impacts—of the nation's transportation system. The data should be organized by markets to monitor performance from the perspective of system users. A market instead of a modal perspective should provide a more relevant basis for analysis of issues that cut across modes and involve comparisons among modes and among broader national objectives that are at the heart of most current and future strategic policy choices facing the department. Development of analytic models and tools, such as GIS, should be part of a data system to improve the department's capability to integrate and analyze data in making national policy decisions.

A major product of NTPMS should be a mandated biennial report on the state of the nation's transportation system. This report, which would be made available to policy makers, analysts, and researchers, both within and outside DOT, should provide summary benchmark data from selected indicators on the performance and impacts of the transportation system.

Although NTPMS is to be broad in scope, the intent is not to create massive new data collection programs. The availability, coverage, and quality of existing transportation data for multimodal analysis and strategic policy making are discussed in the following chapter.

NOTES

1. In contrast, traditional long-range or comprehensive planning is more goal and program oriented, and more focused on the internal environment and a single scenario for the future (Bryson 1989, 7,8).
2. GIS technologies for national transportation policy analysis are also discussed in Appendix B.
3. The committee recently reached consensus on a 1:1,000,000 scale U.S. map, which will provide adequate links to enable use at the national level. The underlying data base will be composed solely of geographic data on links and nodes; data attributes will be organized as separate modules. This decentralized approach will help keep the system current (i.e., if all the attribute data are not in place or updated, the system will still be operational) (personal communication with Arlene Dietz, Director, Navigation Data Center, U.S. Army Corps of Engineers, June 17, 1991).
4. A report similar in concept—*The Condition of Education*—provides key indicators of the health of education and summarizes major trends. The report, which is prepared annually by the National Center for Education Statistics, is now mandated by Congress.
5. Appropriations to support this report dropped to zero in fiscal year 1991; the cost of preparing the report will most likely be paid by users in the future.

REFERENCES

ABBREVIATIONS

DOT	U.S. Department of Transportation
TRB	Transportation Research Board

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3

Meeting Data Needs

Substantial data exist about the transportation system, but fall short of providing the information needed to inform policy makers about the strategic issues facing the U.S. Department of Transportation (DOT). In this chapter key areas are defined in which multimodal data are missing or additions to existing data are needed to enhance intermodal comparisons and provide the basis for monitoring system performance and impacts. The range of organizations that must cooperate jointly to make these data available also is suggested.

Changes in the data environment of the 1980s have affected both the availability and cost of data collection. Deregulation, the Paperwork Reduction Act, competitive concerns of private providers, and cost are all potential constraints on data collection. However, incentives exist for public-private collaboration in data collection. Issues and opportunities for private involvement in the provision of transportation data for strategic policy making are discussed.

New information systems technologies, such as electronic data interchange (EDI), are being developed and implemented, with the potential to automate certain data functions and link together multiple data bases. These systems provide opportunities for cost reduction as well as improvements in the speed, reliability, and quality of data collection and analysis. Opportunities for harnessing these new technologies for linking and aggregating data for national policy making are also explored in this chapter.

MAJOR SOURCES OF NATIONAL TRANSPORTATION DATA

Transportation data are extensive but decentralized both within DOT and outside the department (Table 3-1). The roots of this

TABLE 3-1 MAJOR SOURCES OF NATIONAL TRANSPORTATION DATA

Organization Type	Agency	Data Focus
U.S. Department of Transportation	Office of the Secretary	International, aviation
	Office of Commercial Space Transportation	Space transport
	Research and Special Programs Administration	Aviation, hazardous materials, pipelines, multimodal
	Federal Aviation Administration	Aviation
	Federal Highway Administration	Highways
	National Highway Traffic Safety Administration	Highways
	Urban Mass Transportation Administration	Public transportation
	Federal Railroad Administration	Rail
	Maritime Administration	Water
	U.S. Coast Guard	Water
	St. Lawrence Seaway Development Corporation	Water
Other federal government agency	Bureau of the Census	Multimodal
	U.S. Army Corps of Engineers	Water
	Interstate Commerce Commission	Trucking, rail, intercity bus
	U.S. Department of Agriculture	Trucking, rail, water

NOTE: See text for discussion of private sector data sources.

situation lie in the decentralized nature of the federal statistical system as well as the development of data programs within the department itself.[1]

DOT was a latecomer in the national statistical system. When the department was founded, national transportation statistics were embodied in the System of National Accounts managed by the U.S. Department of Commerce[2] and the regulatory data programs of such agencies as the Interstate Commerce Commission (ICC), Civil Aeronautics Board (CAB), and Federal Maritime Commission. All of these programs and their data sets were modally focused. Although responsibility for na-

tional transportation policy making was largely centralized within DOT, these major transportation data activities remained outside the department. With deregulation, some of these activities were reduced (e.g., ICC transportation data programs), whereas others were transferred to the department (e.g., CAB aviation economic data programs).

New data programs were established within DOT, but their primary purpose was to serve the missions and programs of the modally focused operating administrations. The modal focus of the department is evident today. DOT's largest statistical programs (those with funding that exceeds $500,000 per program) reside in the operating administrations (Table 3-A, at end of chapter); projected funding for these major data programs, which will reach nearly $50 million in fiscal year 1991, is heavily concentrated in three agencies—the National Highway Traffic Safety Administration (NHTSA), the Federal Highway Administration (FHWA), and the Federal Aviation Administration (FAA).[3] Of course, this is where most of the department's programs and most of the nation's transportation activity are focused. In contrast, funding of statistical activities that cut across the modes, many of which are housed within the Research and Special Programs Administration and its Volpe National Transportation Systems Center, reached about $660,000 in fiscal year 1991 (Table 3-B, at end of chapter). The sum of funding for these multimodal data programs barely exceeds the Office of Management and Budget (OMB) criterion of $500,000 for a single major statistical program; currently they account for slightly more than 1 percent of DOT's major statistical programs.

Congress has played an important role in the development of data bases for national transportation policy making, but these efforts are still largely modally focused, reflecting the modal orientation of the congressional committee structure. In the mid-1970s, prompted in part by congressional concern over the deterioration of the nation's infrastructure, FHWA and the states developed a highway performance monitoring system (HPMS) to provide a more consistent basis for long-term monitoring of the condition of major highways built with the assistance of federal funds, including the Interstate highway system.[4] More recently, Congress directed FAA to develop a set of standard indicators to measure the safety of the aviation system consistently over time (FAA 1989).

State and local governments are not major producers of national transportation data programs, although they provide considerable data to DOT primarily through reporting requirements of Federal-Aid programs that are aggregated by DOT to provide national summary data.

These include, for example, HPMS and other FHWA statistical programs, the Section 15 reporting requirements for Urban Mass Transportation Administration (UMTA) grant recipients, and FAA reporting requirements for airports.

Private involvement in transportation data collection has grown in the wake of deregulation. Many industry associations now compile regulatory data on large carriers, which are still collected by ICC, for their membership. Some also conduct special surveys for smaller carriers that are no longer required to report. For example, the Association of American Railroads conducts an annual survey of regional and local railroads to obtain basic information (e.g., revenue, employees, commodities carried, etc.) about this growing industry sector from which ICC no longer requires detailed reporting. Finally, private vendors may take public source data, compile them in computerized formats that organize the data for analysis, and sell them. For example, this practice has been the main way of disseminating the large volume of economic, financial, and operating data on the airlines to private users (Carey 1990, 10,11).

Appendix A provides more detailed descriptions of some of the major national transportation data programs within and outside DOT. The large number of data bases cataloged in this appendix suggests the range of transportation data programs. However, many of these programs are used for administrative and operating purposes and are not well structured for policy analysis.

DATA DEFICIENCIES

Despite the existence of extensive transportation data programs, significant deficiencies exist in the data needed for national policy making. It is beyond the scope of this study to detail all data gaps and potential areas for improvement, nor would such a list indicate priority areas for attention. Instead, the report is focused on major areas of need: (*a*) supplying critical missing data and (*b*) integrating and supplementing existing data in areas for which DOT continues to have major regulatory (e.g., safety and the environment) and mission responsibilities (Table 3-2). These needs are discussed within the broad framework for organizing data for the national transportation performance monitoring system (NTPMS) (i.e., by supply, demand, performance, and impacts) defined in the previous chapter. For some data categories, more research is needed to identify the appropriate data to

measure and collect; these areas are described in the following discussions of each data category.

Data on Supply and Demand

The biggest gap in DOT's multimodal data programs is in flow data. Flow data refer to information on passenger and freight volumes from origin to final destination by trip purpose, distance, mode, and passenger and freight characteristics.

These data are critical to strategic policy making for several reasons. First, they provide basic input for understanding and monitoring how the system is being used and by whom. The data are essential to answering such questions as who or what is moving on the system? for what purpose? by what means? and from where to where? For example, the data are basic to understanding trade flows. Shippers are finding it more cost-effective to transport certain international shipments via rail for the long-distance inland portion of the journey than via the Panama Canal. This intermodal traffic may be significant, but data on the origin (exports) and final destination (imports) of trade flows are not readily available. Thus, it is difficult to know the extent of this traffic or its characteristics (Smith 1989)[5] and the implications for future transportation infrastructure requirements.

Second, passenger and freight flow data can help inform many strategic policy issues facing the department. For example, congestion has been identified as a major problem that affects many transportation modes and results in millions of dollars of delay, increases the cost of transporting goods and people, and ultimately, adversely affects U.S. competitiveness in world markets (DOT 1990, 24). Flow data are essential to identify transportation demand across modes, pinpoint key links within and between modes, and help indicate where investments in new capacity or intermodal links would pay off.

Finally, good flow data should help alleviate multiple data deficiencies. Flow data by mode provide the basic exposure measures of people and cargo for safety analysis; they provide the denominator for calculating accident rates per passenger-mile or ton-mile. Flow data are also basic inputs to forecasts of vehicle activity, which are used to calculate accident rates per vehicle mile and project levels of congestion, emissions, and energy use. Obtaining detailed data for analyses of safety, congestion, and urban air quality, however, is not likely to come from national surveys of passenger and freight movements with

TABLE 3-2 ILLUSTRATIONS OF KEY DATA DEFICIENCIES

Data Category	Data Deficiency	Agencies Involved in Data Compilation	National Policies Served
Supply and demand	Passenger and commodity flow data	DOT; Bureau of the Census	Congestion alleviation; investment decisions; system capacity for civilian and defense needs
Performance			
Safety and personal security	Exposure data Reporting of injuries and nonfatal accidents Measures of system security	DOT	Identification and monitoring of major system safety and security problems; evaluation of alternative safety regulations
Access	Measures of availability, use, and cost of transport services in rural and small urban areas and for handicapped, elderly, and low-income populations	DOT; DOA; DHHS	Investment decisions and development strategies; evaluation of costs and benefits of alternative service delivery mechanisms
Service delivery	Measures of service quality Measures of intermodal performance	DOT DOT; Bureau of the Census; U.S. Customs Service	Investment decisions; identification of impediments to transportation performance affecting economic growth and international trade
Impacts on other national objectives			
Economic growth	Measures of transportation impacts on industrial profitability Expanded data on specific transportation service sectors and their relative contribution to productivity of the sector as a whole	DOT; BLS; BEA; Bureau of the Census	Articulation of value of transportation to economic growth; investment policies to support U.S. competitiveness

National security	Location, condition, and use of transportation facilities	DOT; DOD	Investment strategies for improved military deployment; economic impacts of alternative levels of demand
Environmental quality/land use	VMT, speed data, and other measures of transportation impacts on air quality Measures of transportation impacts on global warming, wetlands degradation, water and noise pollution, and other environmental concerns	DOT; EPA; DOE; states; other agencies with environmental missions	Evaluation of environmental impacts of alternative transportation investments. Identification of magnitude and effects of transportation impacts on the environment; development of policies to mitigate adverse impacts
Energy use	Improved measures of vehicle fuel efficiency	DOT; DOE	Evaluation of energy performance of alternative transportation modes; monitoring energy performance of the transportation sector

NOTE: VMT = vehicle miles traveled; DOT = Department of Transportation; EPA = Environmental Protection Agency; DOE = Department of Energy; DOD = Department of Defense; DOA = Department of Agriculture; DHHS = Department of Health and Human Services; BLS = Bureau of Labor Statistics; BEA = Bureau of Economic Analysis.

out requiring a large sample at a high cost. Supplementing national and regional data with more extensive sampling in selected transportation corridors and major urban areas should provide sufficient detail for national monitoring and analysis purposes.

The most recent source data on passenger and commodity flows date back to the National Travel and Commodity Transportation Surveys conducted by the Bureau of the Census in 1977.[6] DOT's fiscal year 1992 budget submission includes a proposal for restarting these two major surveys. **This initiative should be the primary new data collection priority for NTPMS.** Opportunities for automating portions of the data collection for the proposed Commodity Flow Survey, which are discussed more fully in the last section of this chapter and in Appendix B, offer the potential for reducing survey costs.

Data on Transportation System Performance

Many data programs measure the safety, access, and, to a lesser extent, service, provided by individual transportation modes. Development of NTPMS will require linking and analyzing these data to provide a more consistent and comparable basis on which to assess the overall performance of the system.

Safety and Personal Security

The Statement of National Transportation Policy identified safety as the top departmental priority (DOT 1990, 7), yet the data to monitor the safety and security of the system across all transportation modes are inadequate. For example, although information on accidents and fatalities is available for each of the modes, data on exposure to risk, or activity levels, which are needed to calculate accident rates, are not. [These exposure data are equivalent to the flow data already mentioned; however, they must be made available at a level of detail (e.g., by rural and urban area, by type of road) appropriate for safety analysis.] The authors of a recent TRB report, *Data Requirements for Monitoring Truck Safety*, found that data on travel estimates for trucks, a basic input for computing accident rates, are neither reliably nor consistently measured; thus, government has inadequate information for monitoring truck safety and developing regulations that may affect other modes, such as rail (TRB 1990a, 1). **Improving exposure data should be a priority for safety data col-**

lection for all modes; data on accident and fatality rates and the absolute numbers of accidents and fatalities are needed to track safety performance adequately. Development of the data is an ambitious undertaking, which will require a long-term cooperative effort among the DOT operating administrations, as well as the states, local governments, and others that monitor transportation activity.

Comparability of safety data across modes is also limited by different accident reporting thresholds, particularly for nonfatal accidents. For example, thresholds are not used in UMTA's Section 15 Reporting System to define how serious injuries or property damage must be before it is reported. As a result, it is difficult to compare safety records across transit systems, much less between transit and other forms of transportation.[7]

Cross modal safety comparisons are limited by the absence of data on injuries or by inconsistent definitions of what constitutes an injury. **Better injury data, particularly on serious injuries, is needed for all modes.** Consideration should be given to more widespread use of the Abbreviated Injury Scale, the most widely recognized injury severity scoring system (Rice et al. 1989, 31), which is used by NHTSA in its highway accident data programs. **A cooperative interadministration effort within DOT to work toward consistent reporting thresholds and greater standardization of injury reporting across the modes is desirable.**

Lack of uniform reporting requirements also affects the consistency of safety data collected for each mode; these data are the basic input for any systemwide safety appraisal or attempt to identify causal relationships. Because the vast majority of transportation-related accidents and fatalities occur on highways (DOT 1990, 83), efforts to improve the quality and consistency of police accident reports, the primary source of highway safety data, should have large benefits. NHTSA has developed a uniform coding system for state accident reports—critical automated data reporting elements (CADRE)—to standardize information collection on a core set of data elements essential for highway safety analyses (*IIHS Status Report* 1990, 6) and is engaging in a cooperative effort with the states to implement this system. This approach could be a model for improving other DOT accident reporting systems.[8]

Measures of safety for transportation modes with relatively few, but potentially severe, accidents, such as airplane crashes and pipeline failures, need to be developed. For example, Congress has requested that FAA identify a set of safety indicators that can be used

to track aviation safety on a consistent basis and provide an early warning of potential problem areas or emerging issues (FAA 1989, 1-1). The difficulty is finding reliable indicators that are related to the risk of accident occurrence (FAA 1989, 1-3).

DOT gathers little information on the level of security provided to passengers by different modes of transport, with the exception of the aviation sector.

Access

Perhaps the most fundamental role of transportation is to provide access to markets and personal mobility. An important mission responsibility of DOT is to promote policies and programs that accommodate the mobility needs of U.S. citizens.

Meeting this mission, however, is not always easy. As the rural population has declined, provision of transportation services to widely dispersed, low-density rural areas has become more costly. Low-income, elderly, and disabled populations are particularly affected, because low-density rural areas cannot support conventional public transportation modes (DOT 1989, 28). These groups may also have difficulty finding appropriate modes of transportation in urban areas. The issues of mobility and access are further complicated by lack of a common understanding of what communities, and populations within these communities, require for mobility, and how these needs may differ for local and long-distance transportation. **Data on the delivery of transportation services in rural areas and to low-income, elderly, and disabled populations can help the department monitor changes in the provision of service, identify where loss of service is occurring, and help coordinate development and assistance strategies.**

Rural data are available, but they are scattered. The Essential Air Services Program was begun by DOT in 1978 to ensure continued provision of air service to small urban and rural areas following deregulation. As part of this program, regional and commuter airlines, which serve rural areas, are required to report operating data (passengers enplaned, flight hours, etc.) by market. These data can be supplemented by information from the *Official Airline Guide* on schedules to determine the time and frequency of service. The National Railroad Passenger Corporation (Amtrak) can supply informa-

tion on passenger rail service in rural areas, but data on freight rail service are lacking, except for the largest carriers.[9] Data on other public and private carriers, such as public transit and intercity bus, are limited. The Community Transportation Association of America (CTAA) receives funding from UMTA to prepare a directory of rural (Section 18) transit service providers, including the type of service offered, fleet size, and county(ies) in which service is provided. No data are available, however, on the frequency of service, the number of passengers served, or the cost of service, nor is information collected on private or nonprofit service providers that do not receive UMTA funding. Data on intercity bus activities have not been collected since deregulation of the intercity bus industry in 1982. However, officials at the Bureau of the Census are proposing a new annual survey of charter, rural, and intercity bus service, which could fill this data gap. Overlaying and integrating all these service elements into a locationally defined geographic information system (GIS) would permit analyses of the availability of transportation services in rural areas.

Data on the provision of transportation services to the elderly, handicapped, and disadvantaged are limited. For example, DOT is issuing regulations to implement the American Disabilities Act of 1990 that are likely to cost transportation providers hundreds of millions of dollars based on a survey from the mid-1970s of the affected population (personal communication with the DOT Deputy Assistant Secretary for Policy and International Affairs, July 16, 1991). UMTA collects some data on the provision of transit services for the elderly and handicapped [Section 16(b)] as part of the CTAA directory. The Department of Health and Human Services (DHHS) also provides funding for transportation services for the elderly and the disadvantaged through programs under the Older Americans Act, Medicaid, Head Start, and the Community Services and Social Services Block Grant Programs. The department is attempting to gather baseline information on the share of DHHS program funds that is used to provide transportation services and identify the service providers.[10]

Improving data on the accessibility of transportation will require DOT to integrate and analyze available data from scattered sources, work jointly with other federal agencies (e.g., DHHS) to separate out data on target populations, and cooperate with industry associations and nonprofit organizations to amplify existing data sources.

Service Delivery

Several of the operating administrations prepare reports on the condition and performance of modal systems, yet together, they do not provide an understandable and reliable basis for comparing the efficiency or quality of service delivered by individual modes or assessing the performance of the system as a whole (OTA 1991a, 18). Coverage should be expanded where possible to include more modes; measures of service quality should be introduced; and methods for measuring intermodal performance should be devised (Table 3-2).

Three DOT operating administrations and the U.S. Army Corps of Engineers (USACE) produce condition and performance reports of varying scope and analytic content. Perhaps the best known of these—FHWA's biennial report on the condition and performance of the nation's highways and bridges—draws extensively on HPMS, a data system that tracks the physical characteristics, usage, condition, and operating performance for a sample of road types. Analytic models are an integral part of the system and provide policy makers with the ability to examine the impacts of various assumptions about travel growth and investment levels on highway performance.

UMTA has prepared a biennial report to Congress on the current performance and condition of public mass transportation systems since 1984, drawing largely on Section 15 data. The reports provide a number of indicators of transit performance as well as estimates of investment requirements to maintain existing systems,[11] but there is little analytic capability to examine the impacts of alternative investment levels on transit system performance or of alternative strategies (e.g., pricing) on transit use.

Since 1987 FAA has included a brief review of the condition and performance of the airport system, which it plans to expand in future years, in its National Plan of Integrated Airport Systems, a report required by Congress (FAA 1987, iii). The review includes some measures of system performance, such as airport congestion and delays, but provides limited information on the consequences of alternative levels of demand or investment on overall system performance.

Finally, USACE publishes biennial data on the performance of locks on the inland waterway system, including traffic levels, type of tonnage carried, and vessel transit time through the locks.

These reports could provide the nucleus of a more integrated look at systemwide performance, if the following additions were made. First,

measures of the quality of service—speed, reliability, frequency—are lacking for nearly every mode, with the exception of aviation and inland waterways, where some measures of delay are available.[12] Because of the importance of performance to users and the prevalence of congestion, such measures should be developed, with some degree of standardization among the modes. FHWA has already launched an effort to improve the measurement of highway congestion in major urban areas through HPMS (Pisarski 1990).

Second, measures of intermodal performance should be developed. Existing performance reports are modally focused and do not provide a picture of performance at modal connecting links. Without these data, the department is poorly positioned to examine barriers (e.g., lack of container standardization, overweight maritime containers) that impede the performance of an increasingly multimodal transport system (OTA 1991b, 11; TRB 1992) and affect economic growth and international trade.

Developing performance measures for all modes could prove difficult, particularly for modes such as rail and pipelines whose facilities are owned and operated by the private sector and where proprietary interests may limit access to data. It may be possible, however, for DOT to gather selected performance data by working cooperatively with private industry groups.

Making progress in improving the comparability of modal condition and performance reports will likely require a special effort by representatives from the various operating administrations to develop more standardized performance measures and agree on common demographic and economic assumptions underlying forecasts, forecast periods, and analytic models that should support performance reporting.

Data on Impacts of the Transportation System on Other National Objectives

Increasingly, transportation policies are being developed in the context of other national policy objectives, such as meeting national security needs and improving environmental quality. Policy makers at DOT must be able to articulate the value of transportation in this broader environment as well as its effect on meeting other national objectives. Gathering the data to measure these impacts requires joint cooperation among federal agencies.

Economic Growth

Transportation is a service industry; it provides inputs to other industrial sectors (Helfand et al. 1984, 9; DOT 1990, vi). To the extent that transportation services improve productivity, permit more efficient allocation of productive resources, and enhance consumer choice, they contribute to economic growth and international competitiveness.

DOT should be able to articulate these linkages if the department is to devise policies and investment strategies to encourage economic growth. At present, these linkages are poorly understood. Moreover, current measures of the productivity of the transportation sector do not reflect the full value of transportation services to the economy. For example, they do not include any measures of the quality of service, a common measurement problem in the service sector generally (Pisarski 1991). **DOT must work jointly with other federal agencies that measure the productivity of transportation and its contribution to the economy—the Bureau of Labor Statistics (BLS) and the Bureau of Economic Analysis (BEA)—in a cooperative effort to understand these linkages and develop more comprehensive measures of the contribution of the transportation sector to economic growth.**

Existing measures of the role of transportation in the national economy should also be strengthened. BEA uses information on the transportation sector as one input in the preparation of summary data on the Gross National Product[13] and the Balance of Payments, key elements of the System of National Accounts. BLS measures the productivity of U.S. service industries including transportation.

These measures are critical indicators of the magnitude and performance of the transportation sector in the general economy, yet they are only as good as the data that support them. BLS measures of transportation productivity illustrate the data problems related to productivity measurement. BLS measures labor productivity as output per worker hour; output is expressed either as a physical quantity (i.e., passenger-miles, ton-miles) or as a value of the service performed (i.e., revenue) (Dean and Kunze 1991, 1-7). The data from which BLS derives the output component of its productivity index cover only a limited portion of total transportation activity. This situation is partly a result of changes in the sector following deregulation, changes which have not yet been captured in data programs. The Bureau of the Census has responded by planning a significant expansion of its 1992 Economic Census of Transportation and proposing an expanded program of an-

nual surveys (see Appendix A, pp. 137–139). The Boskin initiative, which proposes a 5-year, $230 million program to improve the quality of government economic statistics, may also provide some additional funding for transportation data as part of an overall plan to increase the coverage of the service sector (Executive Office of the President 1991). **These efforts should receive strong support from DOT.**

National Security

The Persian Gulf War provided a vivid illustration of how vital transportation is to national defense. Fortunately, the adequacy of the transportation system to meet the "just-in-time" delivery of the military force as well as civilian demands was tested in a recessionary environment with considerable slack in the system.

Of course, the timing and duration of military emergencies cannot be projected with any certainty; **the Secretary of DOT, however, should be able to assess what impact different levels of demand, military and civilian, would have on economic performance; identify where added investment in facilities would provide the greatest benefits in improved military deployment capability; and evaluate how the special requirements of military equipment (e.g., ammunition shipped in containers) would affect commercial activity.**

Collecting the data to address these questions is complex, time-consuming, and costly, because of the special characteristics of defense transportation data requirements. First, the data must be precise regarding the location, physical characteristics, and performance capabilities of transportation facilities. For example, it is not enough to know that there are three bridges rated structurally deficient on primary highways in the metropolitan Miami area. Data on condition and use must be linked directly to specific facilities at specific locations on strategic defense highways. Second, the data must be comprehensive. Defense transportation data needs are concerned with all transportation modes and how they interact; it is frequently at the links between the modes—rail or highway connections to ports, for example—where delays and breakdowns in transporting equipment occur.

The U.S. Department of Defense (DOD) has been working with DOT and the Oak Ridge National Laboratories of the U.S. Department of Energy (DOE) since the early 1980s to develop a national transportation data base integrated into a GIS to provide the information

needed for strategic defense transportation planning and policy making. The National Highway Network data base, which contains information on the Strategic Highway Corridor Network—a network of highways considered most critical for defense transportation purposes, is the most advanced element of the system (Lewis 1990, 1). Additional data bases are being included, but missing or inconsistent geographical coding is a problem for many data systems, such as the National Bridge Inventory. Obtaining adequate detail on facilities owned by the private sector such as rail lines (e.g., clearances for oversize shipments, gross weight capacity, and traffic volumes) is also a problem. **Improving and expanding this data system will require continued joint action between DOT and DOD. Given the magnitude of the task, the experience of the Persian Gulf War can perhaps provide perspective on which data needs should take precedence.**

Environmental Quality

The Clean Air Act of 1990 introduced changes that will profoundly affect the character of future transportation investments. The act [Pub.L. 101-549, Sec. 101 (f)(2) and (3)] specifies that in nonattainment areas (i.e., large urban areas with unacceptably high levels of ozone and carbon monoxide), proposed transportation projects and programs must conform with and contribute to emission reduction measures specified in Environmental Protection Agency (EPA)-approved state implementation plans (SIP).[14] Thus, the attainment of federal air quality standards will become a critical, and in some cases a controlling, factor in making transportation investment choices in most of the nation's major urban areas (Hawthorn 1991, 17). Transportation control measures, such as transit improvements, high-occupancy vehicle incentives, and demand management measures to reduce congestion, are likely to receive greater emphasis in the future as ways to offset growth in emissions and improve urban air quality (Hawthorn 1991, 21).

Good data are essential to ensure compliance with the act[15] and to enable DOT policy makers to better evaluate alternative investment strategies for balancing air quality concerns with mobility needs. Traffic or vehicle miles traveled (VMT) data are critical to projecting future emissions levels, determining the need for transportation control measures, and monitoring compliance (Hawthorn

1991, 18). States are the major source of VMT data, which are reported to DOT as part of FHWA's HPMS. However, they are not available for all major urban areas,[16] nor do they necessarily provide a representative sample of urban area traffic (Pisarski 1990, 18, Appendix B; GAO 1989, 58). Moreover, forecasting models used to project VMT have consistently underestimated actual traffic growth, suggesting that the models do not include key variables that affect travel demand (Hawthorn 1991, 20).

In addition to VMT, better data are needed on other critical factors that affect emissions levels. For example, traffic speed data are important because emissions levels vary inversely with speed (i.e., VMT increases on congested roads will cause disproportionately larger increases in emissions) (Hawthorn 1991, 19). Currently, good data on speed (i.e., travel time) are simply not collected (Pisarski 1990, 23); average daily traffic counts are not adequate to measure emissions levels, which vary as a function of speed, which changes throughout the day. Vehicle operating conditions also affect emissions levels; vehicles operating from a "cold start," that is, sitting idle for 1 hr or more, will produce more emissions than those operating from a "warm start." Trip data (i.e., origin and final destination) are needed to measure this factor, but are not readily available by urban area. Finally, better data are needed on vehicle mix (heavy trucks, light trucks, passenger cars) and fuel use (diesel versus gasoline), which also have differential effects on emissions levels.

Closing these data gaps will require joint action between DOT transportation analysts and state officials to define appropriate methods of gathering and projecting urban traffic data, DOE energy analysts to provide data on vehicle emissions, and EPA environmental analysts to incorporate these data into models that measure their pollution contribution. Although these data may not all be collected through DOT, the department should be involved in advising state and local officials on how to structure a data collection effort and will likely require summary data by major urban areas for its own monitoring needs and reporting requirements.

Although this section is focused on the impact of transportation on clean air, transportation affects many other environmental concerns—global warming, wetland intrusion, water quality, noise pollution—where the data on impacts, and more importantly, the ability to analyze how these impacts affect the environment, are poorly developed.

Energy

Transportation also has a major impact on energy use. The transportation sector accounts for more than one-fourth of all energy consumed and almost two-thirds of all petroleum consumed in the United States (Greene et al. 1988). The near total dependence of the sector on fossil fuels has important national security implications. Dependence of transportation on fossil fuels also raises environmental concerns, including impacts on urban air quality discussed in the preceding subsection, as well as long-term effects on global climate change.[17]

Considerable data are available from a wide range of sources on total energy use by different passenger and freight transportation modes. However, the data need to be refined and, in some cases, structured differently to address the issues facing the transportation sector today. For example, more needs to be known about the energy efficiency of various types of vehicles and transport modes. These data are of interest to DOT for the following reasons. First, the agency is responsible for regulating motor vehicle fuel economy standards. Second, improvements in vehicle fuel efficiency have been and are likely to continue to be an important factor in achieving the twin goals of reduced energy use and improved environmental quality; for example, one of the most effective ways of reducing emissions of greenhouse gases from the transportation sector is through increased vehicle fuel efficiency (DeLuchi 1990, 168). Thus, it will be important for DOT as well as DOE and EPA to have the capability to monitor the fuel economy achieved by various types of vehicles and transportation modes to gain a better understanding of the energy performance of the sector.

DOE currently collects data on energy consumption and efficiency for personal use vehicles from its Residential Energy Consumption Survey. There is no comparable survey on the nonresidential transportation sector to capture data on energy consumption and energy efficiency of commercial vehicles and other freight transport modes. DOE has issued a notice of request for comments (*Federal Register* 1991) in an effort to determine how best to collect these data.

Energy use data also need to be gathered on a trip as well as a modal basis. Without the data structured in this way, it is impossible to assess the relative benefits of alternative transportation investments. For example, proponents of high-speed rail (HSR) systems contend that one of the benefits of introducing HSR in the United

States is the greater energy efficiency of rail compared with competing air and automobile travel and the cleaner energy source used to power the system (i.e., electricity versus fossil fuels). However, total projected energy benefits may be less if the energy costs of accessing the new system are also considered in initial origin to final destination trip comparisons. **DOT should work cooperatively with DOE to examine opportunities for supplementing existing data surveys where possible to obtain trip data.**

Emerging Trends

Transportation not only affects the environment in which it operates, but is also affected by changes in this environment. Thus, data must also be collected on key trends that are likely to affect the transportation system of the future. For example, changes in demographics will have profound implications for transportation services. The aging of the population is likely to require a different mix of services (e.g., more public transit, more user-friendly highways), and result in more leisure travel that is dispersed in time and space (Johnston 1989, 19). The projected slowing of the population growth rate may mean some saturation in new drivers and car ownership levels with reduced pressure on expanding highway capacity. Other trends, such as regional growth patterns, metropolitan area growth, employment shifts, and changes in technology, are also likely to have important implications on the future demand for and structure of transportation services (Johnston 1989, 16).

Trend data are available from many sources, such as the Bureau of the Census, BLS, and BEA. **The primary need is to develop the capability within DOT to analyze the data from a system perspective to anticipate shifts in demand for transportation services, and user needs for modified or new transportation modes.**

PRIVATE PROVISION OF DATA: ISSUES AND OPPORTUNITIES

Reducing the data deficiencies noted in the previous section requires collecting some new data as well as supplementing existing data bases. The current environment, however, is not conducive to an expansion of data gathering activities. Deregulation has reduced the amount of mandatory data, particularly economic and financial, that must be

reported by the private sector. Federal paperwork reduction measures have been focused on reducing reporting burdens. Private carriers are reluctant to provide information, even to industry associations, that could be helpful to competitors (TRB 1990b, 16). Collecting data, particularly household and business survey data, has become more expensive, while budget constraints keep a tight lid on spending for data.

Within these overall constraints, opportunities exist to balance DOT's requirements for data and the private sector's willingness to provide these data, either directly or through joint data collection efforts. First, with the exception of the surveys discussed in the following subsection, the nature of much of the data needed to develop NTPMS—summary tabulations and trend data—should not raise disclosure concerns or confidentiality problems. Second, the high cost of new data collection efforts should create incentives for collaboration. The private sector has become an increasingly important source of transportation data, as private vendors and industry groups have attempted to fill the vacuum created by the decline in regulatory reporting; DOT cannot afford to engage in duplicative data collection efforts unless the information is extremely policy sensitive. At the same time, private data providers have limited budgets and may be interested in joint public-private data collection efforts, particularly if the data are market focused and performance oriented, reflecting user concerns.

The private sector can be involved in several ways in the provision of data; each raises a somewhat different set of issues.

Direct Data Collection

One of the most common methods of obtaining national data is to survey private households and business establishments directly. The planned National Travel and Commodity Flow surveys would be conducted in this manner. Surveys of this type raise concerns of confidentiality (i.e., protection of the data) and access by users. If the Census Bureau administers the survey—and the DOT plans to use the Census Bureau to take advantage of its sampling frame and confidentiality restrictions to conduct the survey of business establishments for the Commodity Flow Survey—then these problems can largely be circumvented. However, using private contractors may be desirable when survey data are needed at lower cost and quicker turnaround than the Census Bureau can provide; provision must be made for protecting the

confidentiality of these data. **DOT should develop a policy that addresses confidentiality and data access issues as part of the development of NTPMS,** a topic that is discussed more fully in Chapter 4. The results of a multiyear study on Confidentiality and Data Access conducted by the National Research Council Committee on National Statistics, which will be completed by mid-1992, may provide additional suggestions for safeguarding confidentiality while providing access to federal surveys and administrative records for statistical purposes.

Privately Compiled Data or Private Data Sources

Private firms compile and sell data that originate as public information. These vendors add value to the product by "cleaning" the data and putting it in formats that can be readily analyzed and are generally computer accessible. For example, industry associations, such as the Association of American Railroads and the American Trucking Associations, compile and aggregate data collected by ICC and make it available to nonmembers for a fee. Among the advantages of private vendors are their specialized expertise in information processing technologies and the timeliness of the products they offer. **To the extent that DOT can obtain services like these in useful form more cost-effectively from the private sector than from developing the expertise itself, the services should be purchased from private vendors, or the department could franchise private vendors to provide these services.** DOT should be able to negotiate favorable terms when it provides data to the private sector for value-added applications, such as provision of a limited number of free machine-readable copies for government use.

DOT should also consider opportunities for purchasing transportation data directly collected by the private sector, such as surveys conducted by industry associations, or engaging in cooperative data gathering efforts. DOT analysts should fully understand the methods and limitations of privately provided data, such as representativeness of sample data to the underlying population, sampling errors, and confidence levels. Where the data are to be used by DOT as input for critical policy evaluations instead of monitoring purposes, the quality and neutrality of the data should be scrutinized much more closely.

Confidentiality issues will also have to be worked out. If DOT needs detail on individual respondents, it will have to guarantee a level of

confidentiality that will not breach the arrangements under which the initial data were collected.

Joint public-private data collection efforts offer another way for DOT to obtain data in the form it needs at a reasonable cost and with a minimum of burden on private providers. The desirability of obtaining the data is likely to be greater for both parties through joint development of a survey or addition of questions to an existing survey and shared costs. For example, the U.S. Travel Data Center conducts a national travel survey, based on monthly surveys of a national probability sample of 1,500 U.S. adults, on intercity trip and traveler characteristics. The survey could readily be expanded to provide additional travel information that would complement other national sources of intercity passenger travel data and could be of interest to both DOT and the U.S. Travel Data Center. Although some joint data collection may be possible through contracting, DOT should explore the feasibility of other, more flexible, arrangements for cost-sharing cooperative ventures with the private sector.[18] The Volpe National Transportation Systems Center, for example, can accept private funds and engage in multiyear contracts with private industry.

NEW TECHNOLOGY

Applications of advanced technologies to the transportation sector have the potential to enhance the speed and quality of data collection and analysis, while reducing the cost and burden of reporting. Two main areas of opportunity, which are described in more detail in Appendix B, are (*a*) automation of traditional data collection methods and (*b*) development of new technological systems for transportation management and operation with potential data spinoffs. GIS, which are not a new technology, but whose sophistication has expanded with advances in personal computers and computer graphics, are also discussed.

The first area includes techniques for automating surveys and data recording. For example, computer-assisted telephone interviewing (CATI) provides automated dialing, electronic editing and scanning of responses, and even automated sampling and selection of survey respondents. Hand-held "clipboard computers," which are being promoted by NHTSA, provide police with computers even smaller than laptops for direct entry of accident data with built-in editing and coding checks to reduce or eliminate data entry errors. The data can

be directly uploaded to state computers, both speeding data processing time and reducing multiple data entry and potential for error. These technologies are available and in use; their potential for enhancing the speed and quality of data collection has been demonstrated.

The second category of technologies includes systems such as electronic data interchange (EDI) and intelligent vehicle-highway systems (IVHS). EDI allows for electronic communication among shippers, carriers, and third party services and automated linking of their respective documents in a paperless records system. In a cost-cutting move, the U.S. Customs Service now requires electronic filing of customs documents through an automated manifest system; bar-coded invoices enable carriers to move swiftly through ports of entry (Hanelt 1989, 7). Consideration is being given to linking customs data with domestic freight flow data to be collected by the proposed Commodity Flow Survey in order to learn more about the foreign trade component of freight movements. These data, if gathered by traditional survey methods, could only be obtained at great cost and respondent burden, if at all (Appendix B).

IVHS technologies, such as on-board vehicle computers that monitor vehicle activity (e.g., hours of operation, miles traveled, fuel consumed), automated traffic sensing and control devices that monitor real-time changes in traffic, and satellite tracking systems that provide precise locational information, also have the potential to provide trend data that could be aggregated for national monitoring purposes (e.g., determining vehicle fuel efficiency by classes of vehicles or tracking changes in traffic volume by area and road type). Because the current focus of these technologies is primarily on improving system management and operations, however, their potential as data collection tools has not been thoroughly investigated. **DOT should examine the data collection potential of these systems, particularly those such as IVHS, for which the department has a significant research program.**

GIS are computer-based systems that provide a powerful tool for analysis of geographically oriented data. Because most transportation data are spatially dimensioned, they lend themselves to GIS applications. GIS provide a particularly effective way of integrating modal data to enhance intermodal comparisons and examine the impacts of changes in the supply or demand of transportation services on system performance. **DOT should build on its existing GIS capabilities, particularly their application as an analytic support tool for NTPMS.**

FINDINGS AND RECOMMENDATIONS

Transportation data are plentiful, but inadequate for national policy making. The biggest gap in DOT's multimodal data programs is in passenger and freight flow data. These data provide basic system information on who or what is moving, by what mode, and from where to where; they are also basic input for other desired system indicators. Flow data provide an exposure measure for calculating accident rates per passenger-mile or ton-mile. They are a critical input to forecasts of vehicle activity, which affect projections of congestion, estimates of emissions levels in urban areas with unacceptably high levels of ozone and carbon monoxide, and monitoring of energy use by the transportation sector. A departmental priority should be the collection of national passenger and freight flow data, which have not been gathered since 1977. Although national surveys will not provide the data for detailed analyses of local congestion or air quality problems, additional sampling in major transportation corridors and urban areas should provide adequate detail for national monitoring and analysis purposes.

Development of NTPMS will also require improving the comparability of data collected on individual transportation modes to enhance intermodal comparisons and provide an assessment of overall system performance. Existing data must also be integrated and supplemented to enhance the capability of the department to determine the contribution of the transportation system to such other national objectives as economic growth, national security, environmental quality, and energy use. DOT must work cooperatively with the operating administrations, other federal agencies, and the states to develop these data.

Opportunities for using data that are gathered by the private sector or collaborating with the private sector in data collection efforts should be explored as an alternative to new data collection efforts. Advances in data gathering and information processing technologies have the potential to reduce costs and reporting burdens while improving the speed and reliability of data collection and analysis. The areas of greatest opportunity for application to developing NTPMS, such as automated surveying methods, electronic linking of records through EDI, automated vehicle and traffic monitoring through IVHS technologies, and

integration of data into GIS for analysis, should be carefully investigated.

Acting on these opportunities requires a focal point within DOT for taking lead in making these data available. Changes in institutional arrangements within the department to meet this goal are examined in the next chapter.

NOTES

1. Information for this section on the evolution of transportation statistics was drawn from a background paper prepared for the study committee by Alan E. Pisarski, consultant to the project, in October 1990.
2. The System of National Accounts includes the accounting of goods and services produced and received, the gross national product system, and foreign trade statistics; price indices and employment statistics may also be considered part of this system. The system is planned and managed by the Bureau of Economic Analysis of the U.S. Department of Commerce and the Bureau of Labor Statistics of the U.S. Department of Labor; data collection is handled primarily by the Bureau of the Census.
3. Until 1988, FAA's data collection programs were characterized as operational information systems and not as statistical programs subject to the $500,000 Office of Management and Budget (OMB) reporting threshold.
4. Congress required biennial reporting on the condition and performance of the nation's highway system in 1968. HPMS was implemented in 1979 to provide a more consistent source of highway data not only for the congressional report, but also for FHWA policy, planning, and operating purposes.
5. As part of the move to automate customs data, trade documentation forms have been modified to include new data elements, including the state of the origin and final destination for exports and imports, respectively. However, the data are incomplete and inaccurate (Hanelt 1989, 8).
6. The 1982 Commodity Transportation Survey was attempted with a reduced budget, but technical problems limited the usefulness of the survey. The 1982 and 1987 National Travel Surveys were canceled because of lack of funding. The Nationwide Personal Transportation Study, in which a national sample of households is surveyed about the amount and nature of personal travel, is focused primarily on intracity travel; only 1 percent of the vehicle trips reported in the latest survey in 1983–1984 were trips of 75 mi or greater (Klinger and Kuzmak 1986, Vol. I, 1–7).
7. UMTA issued an advanced notice of proposed rulemaking (*Federal Register* 1990), requesting comments on ways to improve the quality and consistency of its safety data, among other revisions to the Section 15 program.
8. Police reports on fatal truck accidents, which provide the basis for the truck subset of NHTSA's *Fatal Accident Reporting System*, have been supplemented by a data base on trucks involved in fatal accidents (TIFA) developed by the University of Michigan Transportation Research Institute under the

sponsorship of the motor carrier industry, which provides considerable supplementary detail on the vehicle, driver, and carrier through merging of motor carrier accident reports and selected follow-up interviews.

9. The annual survey of regional and short-line railroads conducted by the Association of American Railroads does not contain origin and destination information.
10. DHHS is focusing on programs for the elderly, Medicaid, and Head Start and has contracted with CTAA to provide the data. The limited reporting requirements for the block grant programs preclude trying to learn what share of these funds is expended on transportation services.
11. With the exception of the one-time Rail Modernization Study, which was completed in 1987, up-to-date information is unavailable on the condition of fixed transit facilities, such as rail stations or bus maintenance and operating facilities (Zimmerman 1989, 2).
12. Delay measures, however, are frequently flawed. For example, aviation on-time flight performance data measure delays from official airline schedules. This performance measure may not provide a reliable indicator of delay, because carriers may simply build in a delay factor in their scheduling.
13. Through its input-output tables, BEA measures for each industry the value added by inputs from every other industry, the net product of which is the gross national product.
14. States have the responsibility to inventory emissions contributing to violations of national ambient air quality standards, track these emissions over time, and ensure implementation of control strategies that reduce emissions and move areas toward attainment. The act, however, specifies that in preparing SIP, states must provide for consultation with affected agencies, such as state departments of transportation, local metropolitan planning organizations, state departments of the environment, local air agencies, and other local officials (Hawthorn 1991, 20).
15. The Clean Air Act requires EPA, in consultation with DOT, to issue VMT forecast guidance by May 15, 1991; to update transportation and air quality planning guidelines to coordinate SIP preparation and monitoring within 9 months; to determine the emission reduction potential as well as costs and benefits of various transportation control measures within 12 months; and, to submit a report to Congress every 3 years, beginning in 1993, evaluating how well transportation programming is meeting the air quality objectives of the act (Hawthorn 1991, 20).
16. Because the focus of HPMS is on national estimates of road conditions, some states' sampling procedures for urban road conditions provide aggregate data at the statewide level, but are inadequate for measuring conditions in specific urban areas (GAO 1989, 58). However, FHWA requires states to report VMT data by individual urbanized areas by fiscal year 1993, and both FHWA and the American Association of State Highway and Transportation Officials are working to develop national guidelines for traffic monitoring.
17. The U.S. highway transportation sector, for example, contributes about 25 to 30 percent of all carbon dioxide emitted from fossil fuel use, a key contributor to global warming (DeLuchi 1990, 169).
18. Such cooperative ventures are encouraged by the Federal Technology Transfer Act of 1986 (Pub.L. 99-502), which allows federal laboratories to enter into cooperative research with private industry, universities, and others to encourage technology transfer (U.S. Congress 1986).

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ABBREVIATIONS

DOT	U.S. Department of Transportation
FAA	Federal Aviation Administration
FHWA	Federal Highway Administration
GAO	General Accounting Office
IIHS	Insurance Institute for Highway Safety
OMB	Office of Management and Budget
OTA	Office of Technology Assessment
TRB	Transportation Research Board

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TABLE 3-A FUNDING FOR DOT MAJOR STATISTICAL PROGRAMS, FISCAL YEARS 1974–1991

	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990[a]	1991[a]
Office of the Secretary (OST)/ Research and Special Programs Administration (RSPA)[b]	1.4	2.5	3.1	1.3	1.1	0.3	1.1	0.0	0.0	0.0	0.0	2.5	0.0	0.0	0.0	0.0	0.0	0.0
OST	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.6	0.2	1.2	1.4	0.0	1.1	1.4	1.3	2.6	2.4	2.0
RSPA	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.7	0.2	NA	0.2	0.0	1.3	0.9	0.8	1.4	2.6	2.4
Federal Aviation Administration	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	8.5	6.8	10.4	10.0
Federal Highway Administration	4.0	4.9	3.3	3.9	4.6	4.1	4.4	5.7	5.8	5.8	6.8	8.4	8.9	10.2	9.8	10.6	12.6	13.7
National Highway Traffic Safety Administration	7.2	7.1	6.8	11.9	13.0	12.3	14.8	17.4	17.4	16.2	17.8	16.7	16.1	15.6	14.0	17.4	17.2	19.1
Urban Mass Transportation Administration	NA	0.4	0.1	0.9	0.9	0.3	0.0	0.8	2.0	1.9	1.3	1.6	1.5	0.7	1.2	2.2	1.1	1.9
Federal Railroad Administration[c]	1.5	0.8	1.0	1.3	0.8	0.8	0.8	0.9	0.7	0.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total																		
Current $	14.1	15.7	14.3	19.3	20.4	17.8	21.1	26.1	26.3	25.5	27.5	29.2	28.9	28.8	35.6	41.0	46.3	49.1
Constant 1982$[d]	27.7	27.7	23.5	29.4	29.0	23.0	25.0	28.0	26.3	24.4	25.4	26.2	25.3	24.6	29.5	32.6	35.3	35.6

NOTE: Values are in millions of dollars. All federal spending on statistical activities is not included. An agency is defined as having a major statistical program if its net obligations for statistical activities are at least $500,000. Funding for a statisitcal activity may increase or decrease as a result of the cyclical nature of a survey. Such increases or decreases should not be interpreted as a change in agency priorities, but as a normal consequence of the nature of the program. Agencies also experience increases or decreases in their budgets because they conduct one-time surveys or studies in a particular fiscal year. NA = not available.

[a]Estimate.

[b]Data source for 1974–1980 and 1985 shows a combined figure for OST and RSPA.

[c]Does not meet the reporting threshold of $500,000 for 1984–1989.

[d]Figures are deflated using the gross national product (GNP) price deflator as reported in the U.S. budget.

SOURCE: Compiled by the Center for Transportation Information, Volpe National Transportation Systems Center, from OMB (1988–1991).

TABLE 3-B FUNDING FOR DOT MULTIMODAL DATA PROGRAMS, FISCAL YEARS 1974–1991

	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990[a]	1991[a]
Commodity Transportation Survey	0	550	620	0	0	0	0	0	0	0	0	0	0	0	0	0	0	250
National Travel Survey/ Nationwide Personal Transportation Study	0	200	567	1,195	1,751	0	0	150	800	495	270	0	80	250	750	80	230	305
Journey-to-work	0	165	870	715	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Inland U.S. foreign trade	0	158	354	375	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Foreign trade	150	150	150	159	150	150	150	150	150	150	45	45	45	45	45	45	45	45
OST and RSPA[b]																		
National transportation policy	2,000	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Information management	0	0	0	100	150	200	300	150	0	0	0	0	0	0	0	0	0	0
National Transportation Statistics, Transportation Safety Information Report, etc.	200	200	200	115	240	300	423	321	208	211	182	180	156	135	121	124	124	0[c]
Emergency transportation	0	0	0	0	50	161	182	170	325	367	385	430	0	0	192	120	85	60
Subtotal	2,200	200	200	215	440	661	905	641	533	578	567	610	156	135	313	244	209	60
Total																		
Current $	2,350	1,423	2,761	2,659	2,341	811	1,055	941	1,483	1,223	882	655	281	430	1,108	369	484	660
Constant 1982 $[d]	4,611	2,509	4,528	4,045	3,328	1,063	1,248	1,008	1,483	1,173	816	588	246	368	917	293	369	478

NOTE: Values are in thousands of dollars.

[a]Estimate.

[b]Does not include RSPA's Hazardous Materials Information System.

[c]Transferred to a user fee basis.

[d]Figures are deflated using the GNP price deflator as reported in the U.S. budget.

SOURCE: Compiled by the Center for Transportation Information, Volpe National Transportation Systems Center, from OST and RSPA budget documents.

4

Organizational Issues: Managing the Data

The need for more effective and permanent institutional mechanisms within the U.S. Department of Transportation (DOT) to ensure the collection and analysis of data to support informed national transportation policy making is recognized in the Statement of National Transportation Policy (DOT 1990, 124). The committee's recommendations for establishing a new organizational structure to carry out these tasks are presented in this chapter.

OVERVIEW

The deficiencies of transportation statistics for national policy making are a longstanding problem.[1] Nearly a decade before DOT was established in 1967, the congressional Subcommittee on Census and Government Statistics had described transportation statistics as "one of the most poorly organized of the Federal statistical fields" (U.S. Congress 1959). In 1960, a panel of the National Academy of Sciences' National Research Council found that ". . . (transportation) information is not adequate for scientific examination of the transportation system as a whole, nor its relationships to vital economic, social, political, and defense questions. Without such information it is difficult to identify important problems and promising methods for solution" (NRC 1960).

Soon after it was established, DOT itself noted in a report to Congress that because transportation data are fragmented, incompatible, and contain significant gaps, "it is not possible to examine the transportation system as a whole or in terms of its related parts" (DOT 1969, vii). Transportation Secretary John Volpe submitted a $36 mil-

lion proposal to Congress in 1969 to establish a 5-year program to meet critical transportation information needs (DOT 1969, vii). Full funding for this program was not forthcoming, nor has the collection of systemwide data ever been a priority for the department.[2]

The primary reason for the lack of emphasis on data on transportation as an integrated system lies in the evolution of the department itself as a decentralized group of modally focused operating administrations (Figure 4-1); DOT has been characterized as a "holding company" instead of a unified department (Dean 1991, 10). Throughout DOT's history, transportation issues have been viewed from the perspective of the modal providers, each of which has developed independent data programs to support its missions and programs. Thus, data programs of the department are narrowly centered on modal issues. Moreover, their focus is on issues internal to the operation of individual transportation modes instead of the linkages between the system and the broader external environment that it serves and affects.

During the mid- to late 1970s, in part the result of a government-wide effort to improve federal statistics, attention was focused again on the deficiencies of decentralized transportation data for policy. In a major report on federal statistical programs, the U.S. Department of Commerce noted that ". . . the existing (transportation statistics) system . . . appears incapable of exploring transportation-wide issues" (U.S. Department of Commerce 1978, 227). Establishment of a statistical center within DOT and possible centralization of all DOT data collection activities within the center were recommended (U.S. Department of Commerce 1978, 227).

The concept of a statistical center at DOT received little support, but in 1980, in an effort to improve coordination of departmental data collection activities, DOT designated the Research and Special Programs Administration (RSPA), itself only 3 years old,[3] as the lead agency for coordination and planning of transportation statistical information systems in the department (DOT Order 5300.1), a position it retains today. The Center for Transportation Information was established at RSPA's Volpe National Transportation Systems Center (VNTSC) in Cambridge, Massachusetts, to provide data support for the operating administrations and the Office of the Secretary (OST).

Funding for RSPA and other departmental multimodal data programs, however, soon fell prey to budgetary cutbacks during the 1980s. When adjusted for inflation, funding for multimodal data collection declined from more than $1 million annually in the early 1980s

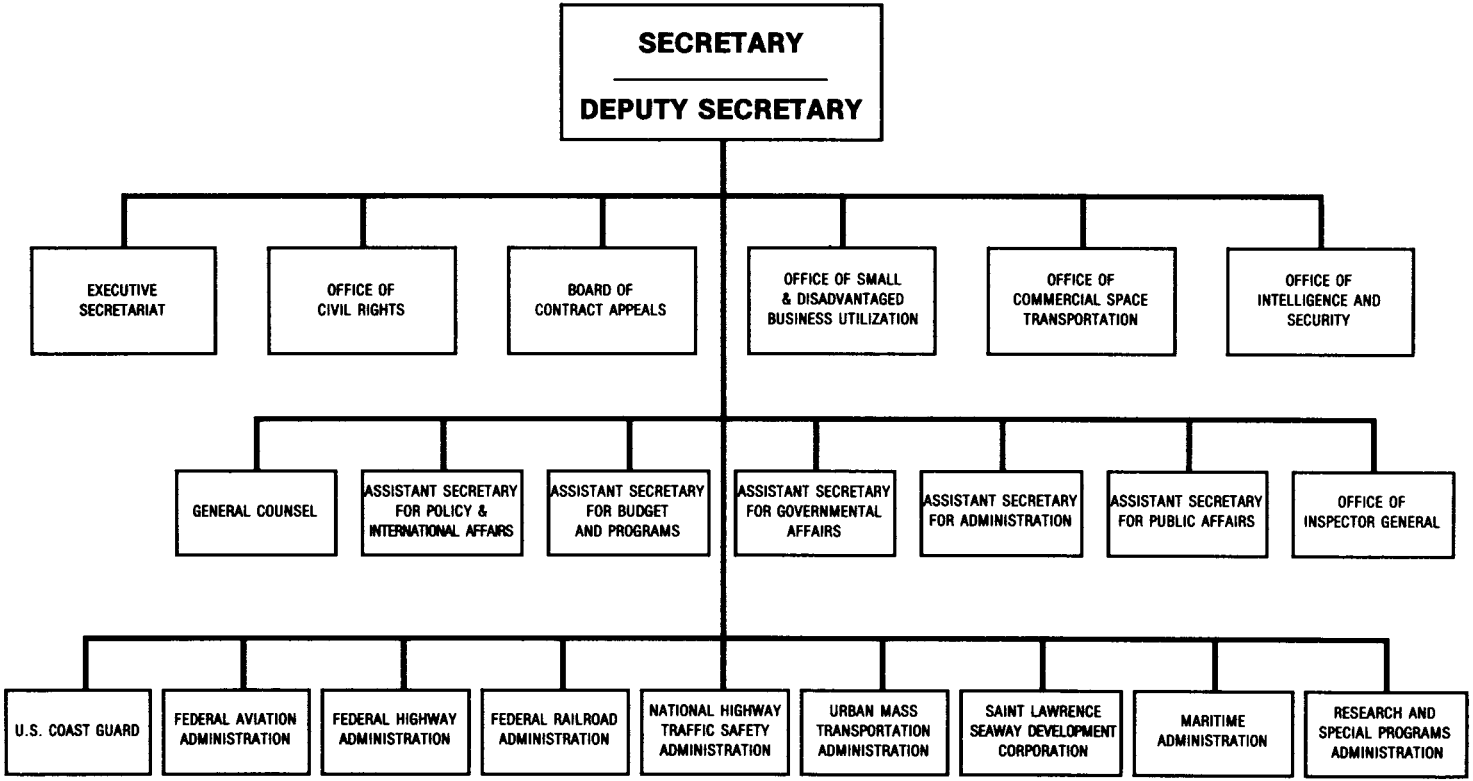

FIGURE 4-1 DOT organization chart, 1991.

to about $400,000 annually by the end of the decade (Figure 4-2 and Table 3-B). From 1974 through 1981, multimodal data programs accounted for about 9 percent of DOT's combined funding for multimodal and major statistical programs;[4] this share dropped to about 2 percent from 1982 to the present (Figure 4-3). Two reports, which contain summary data for all modes—*National Transportation Statistics* and *Transportation Safety Information*—both prepared by VNTSC, received no appropriations for fiscal year 1991; VNTSC hopes to finance these reports from user fees in the future. **The dominance of the modal data programs of DOT's operating administrations has made it difficult to develop a constituency base in the department and adequate financial support to sustain a multimodal data program capability.**

Today, the situation is more conducive to developing this capability. Recent DOT strategic planning engaged operating administrators to work together on issues that cut across individual modes. The DOT leadership has committed to developing an on-going strategic planning capability (DOT 1990, 11), which should encourage continued dialogue among the modes, and has taken steps to enhance the department's data programs for this purpose. Specifically, the secretary has

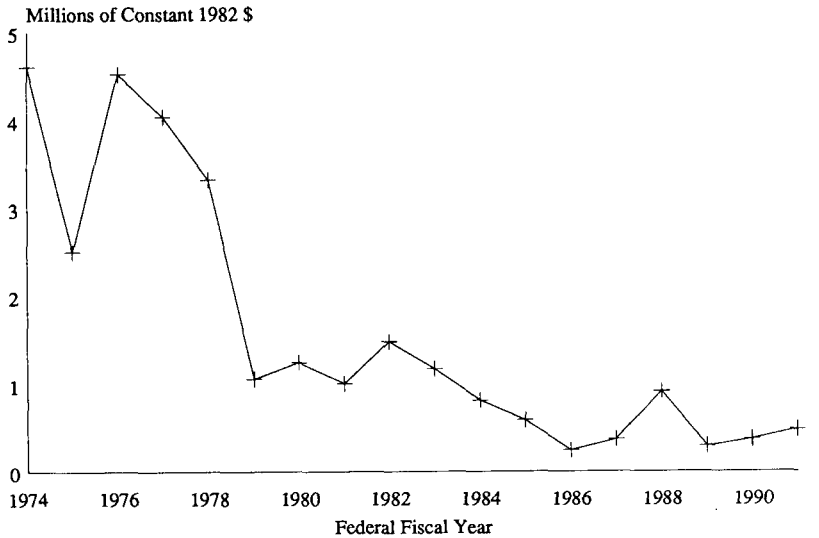

FIGURE 4-2 DOT funding of multimodal data programs; figures are deflated using the gross national product price deflator as reported in the U.S. Budget (data compiled by RSPA's Center for Transportation Information from OST and RSPA budget documents).

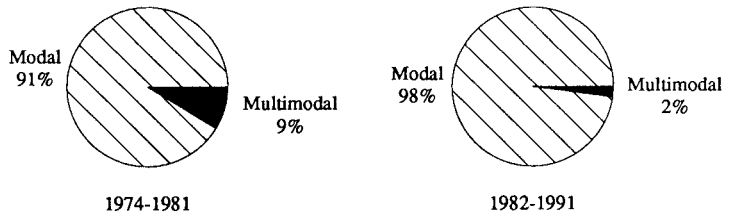

FIGURE 4-3 DOT funding of multimodal and major modal data programs, fiscal years 1974–1981 and 1982–1991 [modal data compiled by RSPA's Center for Transportation Information from OMB (1988–1991); multimodal data compiled from OST and RSPA budget documents].

established two data committees to coordinate both the internal and interagency collection of data for national transportation policy making. In addition, funding to restart the multimodal commodity and passenger flow surveys was included in the department's budgets for fiscal years 1992 and 1993.

Congressional leaders have focused on improvements in transportation statistics for national policy making as part of surface transportation reauthorization bills. The Surface Transportation Efficiency Act of 1991 (S. 1204), which was passed by the Senate in June 1991, mandates establishment of a new Bureau of Transportation Statistics at DOT to compile, analyze, and publish comparative modal statistics and summary data on the condition and performance of the national transportation system. The companion house bill—the Intermodal Surface Transportation Infrastructure Act of 1991 (H.R. 3566)—includes a proposal for creation of an intermodal data base, which would provide, among other information, data on commodity and passenger flows, as part of a new Office of Intermodalism in DOT. **The committee believes that DOT should take advantage of the current attention on transportation statistics to analyze how best to structure its data activities for national policy making and make appropriate permanent organizational changes.**

One option would be for DOT to build on the mechanisms it already has in place—the two data committees—to coordinate the collection of data for the National Transportation Performance Monitoring System (NTPMS). The mission of these committees is to review data needs for national transportation policy making and report annually to the secretary on new data collection requirements and ways to integrate and improve existing data programs. These committees could provide the focal point of a department effort to develop

NTPMS. This approach would also avoid previous objections by the operating administrations and others to the concept of a central statistical unit within DOT that might centralize all departmental data collection activities.

The primary limitation of this option is that it continues the department's ad hoc support of multimodal data programs. Without a clear mandate for developing NTPMS on a permanent basis and a budget and staff to support the data collection and analysis involved, it is unlikely that this approach would be any more successful than past efforts to coordinate transportation data programs for national policy making.

FEDERAL STATISTICAL AGENCIES—A MODEL FOR DOT

Many federal agencies have developed and sustained broad data programs to support agency mission objectives by establishing central statistical offices like the National Center for Education Statistics, the National Center for Health Statistics, and the Energy Information Administration (EIA). Another option would be for DOT to create a Transportation Data Center to meet its multimodal data collection needs modeled on these federal statistical agencies.

Typically, these units have a broad mission to produce data and analyses for policy makers both within and outside their departments. They may be mandated by statute, and many are relatively autonomous within their parent departments. Finally, most have separate budgets, and many have sizeable staffs (Wellington 1988). The following characteristics are among the most critical to the effective operation of federal statistical agencies.

Clear Mission and Mandate

A central statistical unit must have a clearly defined and well-accepted mission and a mandate to carry out this mission (CNSTAT 1991). Many federal statistical agencies, and in some cases specific data collection activities,[5] are mandated by statute (Wellington 1988, 18). Obtaining enabling legislation requires broad-based support and perception of need. For example, Congress mandated creation of the Energy Information Administration in 1978, following considerable controversy over the validity of energy data on supply and demand. Whether similar congressional support will be

forthcoming for a Bureau of Transportation Statistics proposed by the Senate in the surface transportation bill must await passage of the final legislation.

Independence

The independence of a central statistical agency is essential to establish the credibility of its data and products (CNSTAT 1991). Independence is enhanced when the statistical agency head is appointed by the President with approval by the Senate for a fixed term. In many departments, independence of statistical agency directors is further enhanced by their relative autonomy within the department; some statistical agency heads report directly to the department secretary, whereas others are within one to two reporting levels of the top (Wellington 1988, 19, 24). Finally, in some cases, for example the EIA administrator, independence to collect and publish substantive data without departmental approval is ensured by statute (Wellington 1988, 17).

Separate or line-item budget authority for the statistical agency within the overall department budget also helps ensure greater autonomy for the unit in determining what data it will collect and what analysis it will conduct (Wellington 1988, 18). Separate budgets have tended to result in sustained support, although not always full funding, for core data programs. **Given DOT's history of intermittent and ad hoc support of multimodal data programs, a similar funding arrangement is a prerequisite for ensuring continuity of data programs for monitoring purposes and policy analysis.**

The relationship of the statistical agency with other department units, particularly the policy office, must also be clearly defined. Most of the major statistical units in federal agencies are separate from the policy function, which protects the integrity and neutrality of the data they collect (Wellington 1988, 17).

Professionalism

An effective statistical agency is also committed to high professional standards (CNSTAT 1991). This includes the professional qualifications of the agency head, who should be knowledgeable in the subject area of the statistical unit, and of staff. Incentives for attracting high-quality staff may be enhanced by the Boskin initiative, which would establish a Center for Survey Methods at a local Washington

D.C. university and fund a graduate degree program in survey statistics for current and prospective federal statisticians (Executive Office of the President 1991). Advisory committees can also provide valuable technical as well as broader policy advice to statistical agency directors on the scope and quality of data collection (Wellington 1988, 36).

Recommendation

The committee recommends that DOT establish a transportation data center (TDC), adopting the best elements of other federal statistical agencies. It believes that a permanent and separate institution within the department is required to provide sustained support and continuity of data for analysis and informed decision making by DOT policy makers, Congress, and the transportation community. Specifically, TDC should be authorized by statute; given clear authority to develop systemwide multimodal data and analytic support capability for national transportation policy making; and provided a separate budget, qualified director, and full-time professional staff to carry out these activities.

CONCEPT OF A TRANSPORTATION DATA CENTER

TDC would provide a focal point for the collection and integration of systemwide transportation data and would act as the key link among the operating administrations within DOT, other federal agencies and levels of government, and the private sector in the provision of these data.

The primary role of TDC would be to conduct general purpose data activities to support the broad policy needs of the department. Its main responsibilities would include development of the national transportation performance monitoring system (NTPMS), management of the department's general purpose multimodal surveys, and preparation of the required biennial report on the state of the nation's transportation system. **A secondary role of TDC would be to support other offices within the department.** For example, it could provide special analyses for the Assistant Secretary for Policy and International Affairs or for the newly formed Office of Strategic Planning under the Assistant Secretary for Budget and Programs; it could also work with the operating administrations to help make modal data programs more strategically oriented.

The new data collection activities of TDC would be limited. TDC should engage in data acquisition only when the required data fall between or transcend existing programs of the operating administrations, such as multimodal passenger and commodity flow surveys or intermodal data or when the center must supplement modal data programs to improve the comparability of data for systemwide analysis. Mode-specific data acquisition should remain with the relevant operating administrations. Thus, a major source of concern about earlier proposals for a transportation data center—centralization of modal data programs—should not be an issue.[6]

With a permanent central institution charged with collecting systemwide data in place, the department should be in a better position to articulate its data deficiencies and build the case for obtaining the necessary resources to improve them.

FUNCTIONS OF TDC

The activities of TDC should be focused on five core areas.

Identification of Data Needs

Development of the data for NTPMS to support national transportation policy making will require a detailed assessment of what information is required, to what extent it already exists, how readily it can be accessed, and, where data are missing, what the priorities should be for collecting them.

Drawing on the expertise of its professional staff and that of the operating administrations, TDC should be responsible for making these determinations and ensuring that the relevant data programs are put in place. Preparation of the required biennial report on the performance of the transportation system should provide a vehicle for defining more precisely where key data are missing or where the comparability of existing modal data from the operating administrations is weak.

A thorough inventory of existing transportation data bases and an assessment of the compatibility of computer hardware and software systems affecting data integration could also be part of this effort. Periodic inventories of the major data programs of the department and related agencies have been conducted, but they have typically been one-time surveys.[7] As a byproduct of this inventorying effort, TDC

could act as a data depository for the department, developing an electronic inventory of departmental data bases, which would provide a brief description of the available data and a point of contact regarding more detailed information about the contents of the data bases and conditions under which they can be accessed.

Data Compilation

New data collection activities of TDC would be limited and highly focused on multimodal surveys and intermodal data. Management of the proposed National Passenger and Commodity Flow surveys, which are currently being handled by ad hoc informal working groups, should be assumed by TDC to ensure adequate and sustained funding to complete the surveys.

Perhaps equally important, TDC should take responsibility for obtaining and linking modal data from the operating administrations and aggregating them into time series for NTPMS. From a data perspective, TDC would operate as a decentralized distributed network, that is, desired data from existing modal data programs would be accessed electronically and linked. Advances in computer technology now enable data integration through sets of networked data bases instead of by centralization of data into one or more large data bases (personal communication with Jane Bortnick, Assistant Chief, Science Policy Research Division, The Library of Congress, December 6, 1990).[8] Linking data should be achieved by creating bridges among existing data sets; generally, this will require adding questions to existing data programs to allow linking of data elements without detracting from the purposes for which the data programs were originally structured.

Compilation of data for performance monitoring will require TDC staff to make numerous decisions about frequency of data collection, desirability of sampling in the use of administrative records, level of geographic or other detail for analysis, and the like. Thus, an important activity of the data center should be the development of a long-term plan for data collection that provides guidelines and procedures for treating these issues.

TDC staff should also keep abreast of new technologies that could enhance the quality and reliability and reduce the cost and burden of data collection and look for appropriate applications in developing NTPMS.

Data Standards and Quality Assurance

A far more challenging task is improving the comparability and quality of the source data. This will require a long-term cooperative effort among TDC, the operating administrations, and other data providers. TDC should take the lead in setting the necessary standards for data comparability—establishing common definitions and common assumptions about travel demands and economic forecasts and developing common standards for survey methods (e.g., data collection procedures, sampling methods, quality controls)—for data programs that will provide the key source data for multimodal analysis and policy making. **A technical advisory committee of outside experts in transportation statistics and analysis should be established to provide periodic technical advice to TDC on setting data standards.** This group would help ensure that the data products of TDC are technically sound and of high quality.

TDC must assume responsibility for the quality of the data it collects. The multimodal passenger and commodity flow surveys, for example, should contain thorough documentation of data collection methodologies and discussion of any data limitations. TDC should also know and disclose the quality of the data it obtains from others, making clear any limitations of the data that might affect analysis for policy purposes.

TDC should also develop a policy on confidentiality as part of its quality assurance program to protect the identity of individuals or businesses involved in providing data. Confidentiality is essential for encouraging high response rates and accurate data (CNSTAT 1991). If possible, the confidentiality policy should be included as part of the legislation mandating the center.

Data Synthesis and Analysis

Turning data into information that is useful for national transportation policy making requires synthesizing, analyzing, and interpreting the data. TDC staff should have the capability not only to collect data, but also to analyze the data and conduct special research studies related to these data. Although the analyst-researcher has different skills than the data producer, the closer the working relationship between the two, the greater the assurance that the data will be structured to produce the desired information and the more likely the limita-

tions of the data will be recognized in interpreting the results (CNSTAT 1991). Not all of the analysis and research could or should be conducted by the center. However, the experience of other federal statistical agencies suggests that an important component of an effective federal statistical unit is "an active research program [that] is integral to its activities" (CNSTAT 1991, 4, 5). The analytic role of the data center should be focused on impartial interpretation and explanation of the data; it should not involve conducting policy analysis or giving policy advice. TDC should simply report baseline conditions and trends and explain what the data mean, combining and summarizing them in forms that are useful for more detailed analysis. For example, it should develop analytic tools like geographic information systems for integrating modal data and enhancing intermodal comparisons and analyses of system impacts from changes in the supply and demand of modal services. Development of modeling capability and other analytic tools, which were discussed in Chapter 2, should also be part of the data center's analysis capabilities.

Data Dissemination

TDC should be responsible for disseminating the data it collects or obtains from others in a format that is useful for both the department and the transportation community. The primary product of TDC will be the biennial summary report on the state of the nation's transportation system. This report will summarize critical time series data and provide benchmarks of system performance through a series of condition and performance indicators.

To the extent possible, TDC's data collection and dissemination activities should be responsive to the needs of data users, both public and private, and its data products should be designed for technical and nontechnical audiences. **TDC should establish a user advisory committee, representing public (at all governmental levels) and private users and providers of transportation data, to assist the center in defining the type of data to be collected for the NTPMS and how it should be structured.**[9]

OPERATION OF TDC

The success of TDC in achieving the goals and carrying out the functions just described will require coordination and cooperation with numerous existing organizations both within and outside DOT.

Operating Administrations

Development of NTPMS will require working closely with the operating administrations and data providers at other governmental levels, such as the states, as the primary sources for much of the data. Publication of the potentially highly visible state of the nation's transportation system report and distribution to a wide audience should offer an incentive for the operating administrations to provide quality input. In turn, TDC could offer assistance to the operating administrations to improve modal data programs for policy applications and enlist support in obtaining funds for this purpose.

Improving the comparability of the modal data programs of the operating administrations will require a long-term cooperative effort. The DOT Transportation Data Committee, formed by the secretary in November 1990, could assist in this activity. The committee, which meets quarterly, was formed as an internal working group to review data needs for policy making; it must report annually to the secretary on new data collection requirements and ways to integrate and improve existing data programs.

VNTSC

RSPA's VNTSC could assist the center in structuring NTPMS. RSPA has the lead responsibility within the department for planning and developing a coordinated program in transportation information, including preparation of the department's only multimodal reports, although limited funding has been available for these activities during the past decade. VNTSC, in particular, has worked informally with several of the operating administrations and has several of the modal data bases on line. VNTSC's familiarity with these data bases would be valuable in assessing the feasibility of accessing data from the operating administrations. Over the years, VNTSC has also conducted several inventories of transportation data programs, a function it could perform regularly for TDC.

OST

Because the primary purpose of TDC is to provide data and analytic support for national transportation policy making, the center should seek input from the two assistant transportation secretaries most involved in policy issues—the Assistant Secretary for Policy

and International Affairs and the Assistant Secretary for Budget and Programs, who has responsibility for the newly formed DOT Office of Strategic Planning[10]—in defining the long-term strategic issues and policy questions facing the department. TDC professional staff would determine what data are needed to inform these policy concerns and put in place the data programs that are needed. Frequent contact between these offices and the data center should help ensure the relevancy of the data collected by TDC for policy analysis. However, because frequent changes in data programs are costly and detrimental to trend analysis, the responsiveness of data programs to short-term policy concerns is likely to be limited. TDC should work closely with OST to anticipate policy issues and related data needs to the greatest extent possible in structuring NTPMS.

Interagency Data Coordination

Development of NTPMS, particularly those data related to assessing the role and impact of transportation on other major national objectives, requires joint cooperation between TDC and other federal agencies. The Federal Interagency Transportation Statistics Committee, which was also established by the secretary in November 1990, could provide the catalyst for greater interdepartmental coordination. Currently, the committee has a broad mandate to provide a forum for federal agencies to exchange information on transportation data needs and programs. This agenda could be more directly focused on the data requirements of NTPMS and the steps needed to strengthen those elements that require interagency data collection efforts.

One way to coordinate interagency collection of transportation statistics would be through formal memoranda of understanding (MOU), borrowing a model used by Statistics Canada to coordinate collection of national transportation statistics. MOU among TDC and other major data providers and users, such as the Bureau of the Census or the Bureau of Labor Statistics, could be used to define and agree on key data needs and data collection programs, as well as on probable sources of funding.

Bureau of the Census

The Census Bureau could provide unique assistance to TDC because of its special areas of expertise. For example, it could work with TDC to develop appropriate policies on issues of confidentiality

and data access as well as statistical methods of data collection. Based on its recent efforts to expand contacts with data users and respondents, the Census Bureau could assist TDC in designing a user outreach and data dissemination program. Finally, jointly sponsored data collection programs could be considered.

Private Sector

TDC should also work cooperatively with the private sector in designing and collecting data for NTPMS. Collaboration could range from purchasing survey data gathered by industry organizations to engaging in cooperative data gathering efforts. Ideally, TDC should be given the authority to enter into flexible cost-sharing arrangements for joint public-private data gathering activities. **The private sector should also be formally represented on the TDC user advisory committee to help define data requirements from a user perspective.**

FINDINGS AND RECOMMENDATIONS

Developing an ongoing data and analytic capability to support informed national transportation policy making requires a permanent institutional structure within DOT dedicated to this purpose. The committee concluded that the ad hoc, incremental approaches of the past have not been successful in creating a sustained consistent base of information, which is necessary to the secretary's national policy, advisory, and decision-making functions. It recommends that DOT take advantage of current initiatives to improve transportation data, both within the department and as part of pending federal legislation, to establish a transportation data center. TDC should be modeled on the characteristics of other successful federal statistical agencies. It should be authorized by statute, have a clear mandate to develop systemwide multimodal data and analytic support for national transportation policy making, and have a separate budget and full-time professional director and staff to ensure commitment to high professional standards.

TDC should operate as the focal point for the collection and integration of systemwide data and act as the key link among the

operating administrations within DOT, other federal agencies and levels of government, and the private sector in the provision of these data. The primary role of TDC would be to conduct general purpose data activities to support broad policy needs, including development of NTPMS, management of the department's general purpose multimodal data surveys, and preparation of the required biennial report on the state of the nation's transportation system. New data collection activities would be highly focused on multimodal surveys that transcend the responsibilities of the operating administrations, such as the passenger and commodity flow surveys, and on data needed to supplement modal programs to improve the comparability of data for systemwide analysis. Modal programs and related data acquisition would remain the responsibility of the operating administrations.

The primary functions of a data center would be to identify data to develop NTPMS; compile the necessary data, drawing on existing public and private data where possible; set standards for improving the comparability of data drawn from existing sources and ensure the quality of its products; synthesize and analyze the data into information useful to policy makers; and disseminate the data to the secretary, Congress, and the transportation community. Two advisory committees—one representing data users and providers, and the other, experts in transportation statistics and analysis—should be established to assist TDC in carrying out these functions.

Cooperation and coordination with numerous existing organizations are essential to the success of these efforts. TDC should work jointly with the operating administrations and other levels of government who provide data such as the states, RSPA's VNTSC, OST, other federal agencies including the Bureau of the Census, and the private sector.

NOTES

1. Material in this section is drawn heavily from two papers prepared for the Strategic Transportation Data Needs Study: *(a)* a background paper by Alan E. Pisarski, consultant to the project, prepared in October 1990 and *(b)* a paper entitled *The Institutional Framework of DOT Multimodal Information*

Programs: A Brief Historical Perspective, prepared by RSPA's VNTSC in November 1990.

2. However, publication of *National Transportation Statistics*, which contains comparative statistics for all of the modes, was begun at this time.
3. The Research and Special Programs Directorate was created in 1977 to take over the operational activities of the Office of the Secretary (OST) and other responsibilities and organizations that did not fit well into the modal administrations, such as hazardous materials transportation, pipeline safety, and VNTSC (Dean 1991, 21). In 1978 the directorate was reorganized as RSPA.
4. Some small overlap may exist between data programs identified as multimodal and those identified as modal, but the vast majority of multimodal data programs are below the Office of Management and Budget (OMB) $500,000 criterion for a major statistical data program (Table 3-B).
5. Four of the data programs of the Energy Information Administration (EIA) as well as an annual forecast of energy trends are required by statute (personal communication with William Dorsey, Director, Office of Planning, Management, and Information Services, December 18, 1990).
6. At least two proposals were presented to create a national data center for transportation statistics. The Transportation Statistics Act of 1975 (H.R. 7778) proposed the establishment of a National Center for Transportation Statistics within OST; concern by other agencies responsible for transportation statistics, such as the Interstate Commerce Commission, and limited support from DOT resulted in the demise of this initiative. In 1978 the U.S. Department of Commerce study mentioned earlier recommended that a statistical center be established within DOT, which also received little support within DOT and from the transportation community (VNTSC 1990, 5-7).
7. The Transportation Research Board prepared an inventory of major transportation data sources and programs in 1981 as part of a study on data needs of nonfederal users of transportation data (TRB 1981, A-17–A-26). VNTSC prepared an inventory of transportation information systems in 1983 (VNTSC 1983) to identify possible duplication among data bases in compliance with the guidelines of the Paperwork Reduction Act.
8. Two major new federal research projects, the U.S. Global Change Research Program and the U.S. Human Genome Project, are considering data systems that synthesize diverse types of information from many different sources through network integration instead of creation of a single large data base (NRC 1990, 72–77; U.S. Department of Health and Human Services and U.S. Department of Energy 1990, 18).
9. This committee should include a statistician, because it is important from the outset to structure any data collection activities in a statistically sound manner.
10. The mission of this office is to encourage and make permanent a strategic perspective within DOT. The department's fiscal year 1993 budget contains a request for $1.5 million to support 4 to 5 permanent positions and 1 to 2 rotating positions from the operating administrations to staff the Office of Strategic Planning.

REFERENCES

ABBREVIATIONS

CNSTAT	Committee on National Statistics
DOT	U.S. Department of Transportation
NRC	National Research Council
OMB	Office of Management and Budget
TRB	Transportation Research Board
VNTSC	Volpe National Transportation Systems Center

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5

Next Steps

Establishment of a transportation data center (TDC) within the U.S. Department of Transportation (DOT) is the key to a long overdue improvement in the availability and quality of data and analysis for national transportation decision making. **The committee recommends that the department move quickly to put TDC in place and proposes the following steps to accomplish this objective.**

IMMEDIATE STEPS

TDC should be legislatively mandated to provide the strongest assurance of permanency. If the proposed Bureau of Transportation Statistics contained in the Senate surface transportation bill survives in final legislation, then the mandate and mission of a transportation data center will be clearly specified. However, **if a legislative mandate is not forthcoming in this congressional session, then the Secretary of DOT should establish TDC administratively.** There is ample precedent for such a step; in 1977 then Secretary of Transportation Brock Adams established the Research and Special Programs Administration by executive action (Dean 1991, 21). Once the data center is established, the secretary should continue to seek permanent authorization through legislation to ensure a clear and continuing mandate.

TDC should be provided a separate budget, a qualified director, and a permanent full-time staff. The committee estimates that an initial annual budget of approximately $20 million is needed in this start-up phase to support a director and small core staff, fund the passenger and freight flow surveys (described in the following paragraphs), and initiate efforts to integrate existing transportation data and develop analytic tools. A 20 million dollar level of effort would mean a substantial increase of about 40 percent over

DOT's current funding of major statistical programs, including multimodal data programs (Tables 3-A and 3-B). However, DOT's total data effort, including the data center, would represent approximately two tenths of one percent of the department's budget of $30 billion, a fraction of the resources involved in regulatory and investment decisions involving billions of dollars.

The director of TDC should be a highly qualified professional, knowledgeable about transportation and experienced in the collection and analysis of transportation statistics. A core staff should be assembled with expertise in transportation data programs and policies, statistics, data base management, data processing, analysis, and modeling.

The first activity of TDC should be to assume responsibility for the national passenger and commodity flow surveys and get them under way. Congress has appropriated $4 million in DOT's fiscal year 1992 budget to start work on these surveys; the department has estimated additional funding requirements of approximately $11 million to complete the surveys (DOT 1990).[1] The data center must ensure that continuing and adequate support of these essential data is provided in the future.

SHORT-TERM STEPS

Once TDC is established, it should begin to develop a national transportation performance monitoring system (NTPMS), the key building block for creating an ongoing departmental capability to monitor indicators of the nation's transportation system and its environment over time. TDC staff should refine the NTPMS framework; identify data requirements more precisely, conducting analyses where needed (e.g., inventories of major existing data bases); define appropriate system performance indicators; and begin to collect the data for time series analysis.

To the maximum extent possible, TDC should tap staff expertise in the operating administrations, the Volpe National Transportation Systems Center, the Office of the Secretary, and the DOT Data Coordinating Committees to assist in these efforts. **It should also establish a user advisory committee** representing public and private users and providers of transportation data, to ensure that the NTPMS framework and data collection efforts reflect the needs and concerns of transportation data users.

TDC should issue an initial report on the state of the nation's transportation system no more than a year after the center is established. This report, which should be legislatively mandated, will provide a focal point for TDC's activities and a vehicle for summarizing the center's findings. The initial report should be viewed as a working document; it should help identify what is known and unknown about the performance and impacts of the transportation system and provide a roadmap for future data gathering and analysis activities.

LONG-TERM STEPS

The most time-consuming task facing TDC is to improve the comparability and quality of existing data. This will require TDC to set standards to improve data comparability and work closely with the operating administrations and other key data providers to enable the center to assemble the data needed for systemwide monitoring and analysis. To assist in this task, TDC should establish a technical advisory committee, drawing on the expertise of the statistics profession as well as those knowledgeable about existing transportation data programs, to help ensure that data compilation is technically sound and feasible.

As TDC expands its efforts to compile the data required for NTPMS and its reporting requirements, it must also work jointly with other federal agencies and the private sector. It should be empowered to enter into memoranda of understanding with other federal agencies to set interagency data collection priorities and responsibilities and collaborate with the private sector in joint data gathering efforts if appropriate. To exercise this authority, the data center should be able to enter into flexible, cost-sharing, cooperative ventures with other public agencies and the private sector, subject to confidentiality constraints.

TDC staff should also identify technological advances that could reduce the cost and enhance the quality and reliability of data collection and analysis and look for suitable applications. A survey of the advanced technologies described in Appendix B, particularly those such as intelligent vehicle-highway systems and geographic information systems in which the department has a research effort under way or an existing capability, would be a good starting point.

CONCLUSION

The long-term success of TDC will depend on the cooperation of many organizations both within and outside DOT. It will also require more resources than the initial $20 million if the center is to launch a serious effort to improve the comparability and quality of existing transportation data programs. In many cases, enhancements of existing data will require long lead times for data providers to respond and adequate resources to acquire, process, analyze, disseminate, and maintain the data.

The center has a broad potential constituency base—the leadership at DOT; congressional supporters from oversight committees; other constituent groups who are concerned with making transportation policy, such as state and local governments, environmental and energy groups; and finally, system users, including shippers, the tourism industry, and the defense establishment.

The department has an opportunity to bring these parties together to reverse long-standing criticisms of the inadequacies of transportation statistics. The recent strategic planning process highlighted the systemic nature of the issues facing the department today and the deficiencies of strictly modally oriented data programs. The Interagency Committee on Transportation Statistics chaired by DOT was recently reestablished after more than a decade to provide a forum for defining mutual data needs and encouraging cooperative interagency data gathering efforts. Pending federal legislation would establish a data center at DOT to provide comprehensive transportation statistics. **DOT must take advantage of these initiatives to create and sustain a permanent focal point within the department dedicated to developing the knowledge base to inform policy makers about the strategic choices that will shape the transportation system of the future.**

NOTE

1. DOT's initial budget request for fiscal year 1992 was $7 million for the multimodal surveys. A lower appropriations level will require that the surveys be performed over a 3- to 4-year period instead of the planned 2-year timeframe.

REFERENCES

ABBREVIATION
DOT U.S. Department of Transportation

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Appendix A
Summaries of Major National Transportation Data Programs

This appendix contains summary descriptions of the major national transportation data programs available for strategic policy making purposes. The majority of the information was provided by representatives of the operating administrations of the U.S. Department of Transportation (DOT), liaisons of other federal agencies to the study committee, and the project consultant.

OFFICE OF THE SECRETARY

Agency Mission

The focus of the Office of the Secretary (OST) of DOT is primarily on policy formulation, resource allocation, interagency and intradepartmental coordination, evaluation of programs, and intermodal matters requiring integration and balancing of modal interests.

The Policy Office of OST is not primarily a statistical agency, but it does collect, publish, and analyze statistical data in support of its mission. Statistical activities include monitoring competition in the airline and maritime industries, monitoring on-time performance of major air carriers, developing legislative proposals, responding to congressional requests for information and special studies, developing policy on transportation issues, supporting international negotiations on aviation matters, and analyzing handicapped access and aviation consumer issues in support of the issuance of regulations.

Current Data Programs

Air Carrier On-Time Performance Report

The 12 largest air carriers are required to submit monthly reports to DOT on domestic flights that are delayed 15 min or more from the

scheduled departure or arrival time at an airport. The regulation requires this information to be reported for only the 31 largest U.S. airports, but the participating air carriers have voluntarily submitted reports for all airports on their domestic systems. A summary report that covers each airline's overall performance and the performance of individual airports by time of day is published each month. Detailed tabulations and a data tape that shows specific flight information can be purchased from the department's Volpe National Transportation Systems Center in Cambridge, Massachusetts.

Nationwide Personal Transportation Study

See Federal Highway Administration (p. 118).

Transborder Surface Transportation Data Project

See Federal Railroad Administration (p. 125).

OFFICE OF COMMERCIAL SPACE TRANSPORTATION

Agency Mission

The Office of Commercial Space Transportation (OCST) was established in 1984 within OST. The provisions of the Commercial Space Launch Act, which gave DOT the authority to regulate U.S. commercial space launch activities are carried out through OCST. Its mission is to facilitate development of a safe and competitive U.S. commercial space transportation industry. OSCT carries out these responsibilities by (*a*) licensing and regulating all U.S. commercial launch activities to ensure that they are conducted safely and responsibly and (*b*) promoting and encouraging commercial space transportation.

Current Data Programs

Two of the data bases that OSCT is developing to support its responsibilities in the rapidly evolving commercial space transportation sector are discussed here.

Space Transportation Analysis and Research

This data base provides information on international space transportation infrastructure and markets. Specifically, it provides information on launch vehicles, payloads (e.g., physical and operating characteristics), future and historical launch events, characteristics and facilities of launch sites, and characteristics of commercial launch service companies (e.g., facilities, products, and services).

Space Accident Data Base

OCST has developed the framework for this data base and entered some data on space-related accidents and incidents for commercial space launches in the United States. The data base encompasses ground, launch, orbital, and reentry accidents and incidents; it provides information on the parties involved and the payload, the date, a description and the sequence of the accident or incident, and the consequences (e.g., casualties, damage, and delays).

RESEARCH AND SPECIAL PROGRAMS ADMINISTRATION

Agency Mission

The mission of the Research and Special Programs Administration (RSPA) is to serve as a research, analytical, and technical development arm of DOT for long-range and multimodal research and development and to conduct special programs. Particular emphasis is given to pipeline safety, transportation of hazardous cargo by all modes of transportation, safety, security, facilitation of domestic and international commerce, and intermodal research and development activities, including university programs.

Current Data Programs

Aviation Statistics

RSPA's Office of Airline Statistics manages the following data programs related to aviation economics and operating statistics:

- Form 41: Schedule T-100(f): Foreign Air Carrier Traffic Data by Nonstop Segment and On-Flight Market is filed by foreign air carriers that provide service to and from the United States. Schedule T-100 contains traffic (e.g., passengers enplaned) and operating (e.g., aircraft departures) statistics by nonstop segments and on-flight markets for scheduled, nonscheduled, and chartered operations. Data are for operations between the carrier's home country and the United States.
- Form 41: Report of Financial and Operating Statistics for Large Certificated Air Carriers (Financial Schedules Only) is filed by large certificated U.S. air carriers. It comprises 15 financial schedules.
- Carrier's Audit Report must be submitted by each large certificated U.S. air carrier whose records are audited by an independent certified public accountant.
- Form 291-A: Statement of Operations and Summary Statistics for Section 418 Operations contains profit and loss data and traffic and capacity statistics. The form is filed by U.S. air carriers operating under Section 418 domestic all-cargo certificates.
- Form 41: Schedule T-100: U.S. Air Carrier Traffic and Capacity Data by Nonstop Segment and On-Flight Market and Supplemental Schedules, T-1: U.S. Air Carrier Traffic and Capacity Summary by Service Class, T-2: U.S. Air Carrier Traffic and Capacity Statistics by Aircraft Type, and T-3: U.S. Air Carrier Airport Activity Statistics are filed by all large certificated U.S. air carriers. Schedule T-100 contains traffic (e.g., passengers enplaned) and capacity (e.g., available seat miles) statistics by nonstop segments and on-flight markets for domestic and international scheduled, nonscheduled, and chartered operations. The supplemental schedules contain summary traffic and capacity statistics without segment or market detail for domestic all-cargo operations, domestic charter operations, and international military charter operations.
- Form 251: Report of Passengers Denied Confirmed Space must be filed quarterly for scheduled passenger service performed with large aircraft (i.e., more than 60 seats), by all large U.S. certificated air carriers and foreign air carriers that provide service from the United States, disclosing the number of passengers who were denied confirmed space and how those passengers were accommodated.
- Form 298-C: Report of Financial and Operating Statistics for Small Aircraft Operators contains five schedules. U.S. scheduled passenger commuter air carriers file three of the five; small U.S. certificated air carriers file all five.

- Form 2787: Passenger Origination and Destination Survey must be filed by certificated U.S. air carriers providing scheduled passenger service. The report includes a 10 percent survey of all tickets except for the largest domestic markets (approximately 1,000 markets), in which a 1 percent sample may be used. All carriers have elected to file a 10 percent sample. The survey provides information on the origin and destination of the passenger, routings by carrier, fare paid, and fare class.
- U.S. International Air Travel Statistics is a program that was recently transferred to RSPA from OST. The compilation of international air travel statistics began in the 1970s under a joint project with DOT, the Immigration and Naturalization Service (INS), and the Travel and Tourism Administration. The project consisted of coding INS Form I-92, completed by international air carriers arriving in and departing from the United States. The information coded from the form included the international airports of embarkation and debarkation, flight number, date, and number of U.S. citizens and noncitizens aboard the flight. The origin and destination information is now being obtained from another form submitted to RSPA by the air carriers, but citizenship data is still being coded.
- Electronic Tariff Information System (Aitlines) is another program that was recently transferred to RSPA from OST. International air carriers are regulated by DOT, so tariffs for changes in passenger fares, rules, and cargo rates must be filed with RSPA's Office of Automated Tariffs. Until fiscal year 1990, tariffs had been filed manually. In January 1989, DOT published a regulation that allows the international airline industry to file electronically with DOT and withdrew the requirement for manual posting at pricing locations. After an experimental program, the automation of international aviation tariffs began in phases. In July 1990, the fares portion of the system was completed and is operational. Future enhancements will include automating passenger rules and cargo rate tariffs.

Hazardous Materials Information System

RSPA's Office of Hazardous Materials Transportation collects the following data on the movement of hazardous materials. A summary of ongoing programs and policies for promoting hazardous materials transportation safety is provided in an Annual Report on Hazardous Materials Transportation. A national overview of safety and enforce-

ment initiatives, and incident and accident data is provided; regulations and exemptions to regulations issued during the year are described; the status of the national safety program is summarized; and areas of future concentration are identified. Statistical summaries of incident and accident data indicate the condition of the hazardous materials transportation industry, and in conjunction with enforcement data, indicate the performance of that industry.

Pipeline Safety

RSPA's Office of Pipeline Safety collects the following data on liquids and natural gas pipelines for the Hazardous Materials Information System. Operators of natural gas transmission and gathering, and distribution pipeline systems, as well as liquids petroleum pipeline systems, are required to file incident and accident reports for any pipeline leak or failure that results in death, injuries that require hospitalization, or property and product loss in excess of specified amounts. These reports provide data about the nature of the incident, apparent cause, and impacts. Annual reports covering inventory data (e.g., miles of pipe by type) and leak repairs are also required of natural gas pipeline operators.

Multimodal Statistical Reports

RSPA's Volpe National Transportation Systems Center is responsible for two multimodal publications:

- *National Transportation Statistics* provides summaries of modal operating and financial data, information on modal performance and safety trends, and supplementary data on transportation's impact on the economy and energy use.
- *Transportation Safety Information* summarizes safety information—accidents, fatalities, injuries, and fatality rates where activity data are available—for all modes.

FEDERAL AVIATION ADMINISTRATION

Agency Mission

The primary function of the Federal Aviation Administration (FAA) is to foster the development and safety of American aviation. More spe-

cifically, FAA is responsible for developing the major policies necessary to guide the long-range growth of civil aviation; modernizing the air traffic control system; establishing in a single authority the essential management functions necessary to support the common needs of civil and military operations; and providing for the most effective and efficient use of the airspace over the United States. The agency is also responsible for rulemaking relative to these functions.

FAA constructs, operates, and maintains the National Airspace System and the facilities that are part of the system; allocates and regulates the use of airspace; ensures adequate separation among aircraft operating in controlled airspace; and, through research and development programs, provides new systems and equipment for improving use of the nation's airspace.

The Airport Improvements Program authorizes FAA to make grants of federal funds to sponsors for airport development and for advanced planning and engineering. FAA also prescribes and administers rules and regulations concerning the competency of pilots, mechanics, and other FAA-licensed aviation technicians; aircraft airworthiness; and air traffic control. It promotes safety through certification of pilots and other technicians, aircraft, and flight and aircraft maintenance schools. Finally, it reviews the design, structure, and performance of new aircraft to ensure passenger safety.

Current Data Programs

FAA maintains a diverse set of data that supports critical activities in safety regulation; airspace and air traffic management; management of air navigation facilities; research, engineering, and development; testing and evaluation of aviation systems; airport programs; registration of aircraft; and others.

Because of the large amount of FAA data, many of which are used for administrative purposes, an attempt was made here to limit the list to those major statistical publications and data bases from which summary statistics and trend data can readily be derived for policy purposes.

Major Statistical Publications

• *Airport Activity Statistics of Certificated Route Air Carriers* is a joint annual publication of FAA and RSPA that contains data on pas-

senger enplanements and tons of enplaned freight (express and mail) by airport, carrier and type of operation, and type of aircraft.

- *Census of U.S. Civil Aircraft* is an annual publication that includes statistical data on the registered civil fleet, air carrier aircraft, and general aviation aircraft, both registered and active, including detailed reports for general aviation aircraft by owner's state and county, and registered aircraft by make and model.
- *FAA Air Traffic Activity* is an annual publication with data on terminal and en route air traffic activity (e.g., takeoffs and landings, aircraft handled, and flight plans filed). The data is collected and compiled from the FAA-operated airport traffic control towers, air route traffic control centers, flight service stations, approach control facilities, and FAA contract-towered airports.
- *FAA Statistical Handbook of Aviation* is an annual publication that presents historical statistical information pertaining to FAA; the National Airspace System (NAS); airports; airport activity; U.S. civil air carrier fleet; U.S. civil air carrier operating data; pilots, mechanics, and other FAA-licensed aviation technicians; general aviation aircraft; aircraft accidents; aeronautical production; and imports and exports.
- *FAA Forecast* is an annual publication of forecasts for key aviation activity and FAA workload measures.
- *General Aviation Activity and Avionics Surveys* is an annual report that presents the results of the General Aviation Activity and Avionics Survey conducted to obtain information on the activity and avionics of the U.S. registered general aviation aircraft fleet. The report contains estimated flying time, landings, fuel consumption, lifetime airframe hours, avionics, and engine hours of the active general aviation aircraft by manufacturer and model group, aircraft type, state and region of based aircraft, and primary use.
- *General Aviation Pilot and Aircraft Activity Survey* is a triennial report that includes data on the type and source of weather information services, trip length in time and distance, pilot age and certification, estimates of total 1990 general aviation operations, fuel consumption, and aircraft miles flown.
- *Rotorcraft Activity Survey* is a special one-time report containing breakdowns of active rotorcraft, annual flight hours, average flight hours, and other statistics by rotorcraft type, manufacturer and model group, region and state of based aircraft, and primary use. Also included are law enforcement and public use rotorcraft, lifetime airframe hours, engine hours, estimated miles flown, and estimated number of landings.

- *U.S. Civil Airmen Statistics* is a detailed annual report containing statistics on pilots, mechanics, and other FAA-licensed aviation technicians and the number of certificates issued.

Data Bases and Data Systems

The following list of major data bases comprises, for the most part, real-time operational data systems; however, summary statistics can be and are regularly derived from them.

- Civil Aviation Security Information System provides information about security checks of airports, air carriers, and security stations; tracks security alerts, bulletins, and summaries; and records reports of arrests made at screening stations, bomb threats, explosion reports, screening device findings, hijackings, and use of K-9 teams.
- Comprehensive Airmen Information System includes information on personal, medical, and certification status of individuals associated with civil aviation operations including pilots, mechanics, flight crews, and others.
- Enforcement Information System contains data about violations of the Federal Aviation Regulations (FARs); violator's identification; the FAR violated; description of the aircraft, engine, or component involved; demographics; and recommended sanctions.
- Service Difficulty Reports System contains reports about abnormal, potentially unsafe conditions in aircraft, aircraft components, and aircraft equipment.
- Simulator Inventory and Evaluation Schedule System contains results of checklist inspection and certification activities, identification and correction of discrepancies, and vital statistics for operators and manufacturers.
- Manufacturing Inspection Management Information System includes parts manufacturer approval supplements, technical standard order authorizations, information on production and quality control activities, type certification conformity inspections, results of applications for airworthiness certification of individual aircraft, reports of production flight tests, export certifications, and information about the private-sector designees authorized by FAA to perform manufacturing and airworthiness inspections.
- National Airspace Information Monitoring System (NAIMS) is an automated data base management system used for tracking and analyz-

ing reported safety-related incidents and rules violations occurring in the NAS. NAIMS subsystems include the following:

–Operational Errors System contains reports on occurrences attributable to elements of the air traffic control system that result in less than the applicable minimum separation distance among: (*a*) two or more aircraft, or (*b*) an aircraft and terrain or obstacles, which include vehicles, equipment, or personnel on runways.

–Operational Deviations System contains reports on controlled occurrences in which applicable minimum separation distances as just defined were maintained, but one of the following situations occurred: (*a*) less than the applicable minimum separation distance existed between an aircraft and protected airspace without prior approval; (*b*) an aircraft penetrated airspace that was delegated to another position of operation or another facility without prior coordination and approval; (*c*) an aircraft penetrated airspace that was delegated to another position of operation or another facility at an altitude or route contrary to the altitude or route requested and approved in direct coordination or as specified in a letter of agreement, precoordination, or internal procedure; or (*d*) an aircraft, vehicle, equipment, or person encroached upon a landing area that was delegated to another position of operation without prior coordination and approval.

–Pilot Deviations System contains reports on actions of pilots that result in alleged violations of airspace or ground air traffic control clearances.

–Near Midair Collisions (NMACs) are reports received from pilots or flight crew members (who were in the cockpit of one of the aircraft involved) stating that a collision hazard existed between two or more airborne aircraft, regardless of aircraft separation distance. The usual criterion for declaring an NMAC is an unintentional proximity of less than 500 ft.

–Pedestrian/Vehicle Deviations System includes reports on any entry or movement on an airport movement area by a vehicle or pedestrian that was not authorized by an air traffic controller.

–Runway Incursions are reports on occurrences at airports that involve an aircraft, vehicle, person, or object on the ground that result in loss of separation with an aircraft taking off, intending to take off, landing, or attempting to land.

• Aviation Safety Reporting System (ASRS) is maintained by Battelle Laboratories under an FAA-funded National Aeronautics and Space Administration contract. ASRS was developed to store reports of situations observed by pilots, controllers, passengers, or mechanics

that compromised safety, or had the potential to do so. Before entry into the data base, the information is evaluated by ASRS analysts and is edited to ensure the anonymity of the reporting individuals. Limited immunity is provided to reporting individuals for inadvertent violation of FAA regulations.

- Accident/Incident System contains environmental data, contributing factors, weather conditions, and personal and medical data about the people involved in aircraft accidents and incidents. The National Transportation Safety Board (NTSB) also investigates accidents involving civil aircraft in the United States and collects data in the NTSB Accident and Incident System on accidents, fatalities, serious injuries, and accident rates per million passenger miles flown and per million aircraft miles flown for U.S. carriers (for scheduled and unscheduled service), commuter carriers, and general aviation.
- Air Traffic Operating Management System contains the number of flights delayed more than 15 min by cause of delay (e.g., weather, air traffic control center volume, airport terminal volume) and by airport. (This delay system should not be confused with the On-Time Flight Performance Reporting System operated by the OST Office of Intergovernmental and Consumer Affairs.)
- Air Traffic Activity System includes monthly information about activity at the FAA air traffic facilities—aircraft operations, aircraft handled, and flight plans filed.
- Aeronautical Information System contains operational and physical descriptions of all civil (public and private) airports; selected military airports, navigational aids, and flight service stations; air traffic control towers, air route traffic control centers, and airways; jet routes, military training routes, and preferred instrument flight rule routes; standard instrument approach procedures; standard terminal arrival routes; standard instrument departure routes; fixed reporting points; holding patterns; restricted, warning, alert, prohibited, and military operations areas; part-time control zones; and U.S. notices to pilots, mechanics, and other FAA-licensed aviation technicians.
- National Forecasting System includes annual forecasts of aviation activity and other selected statistics.
- Air Route Traffic Control Center Forecast is a facility level activity forecast.
- Flight Service Station Forecast is also a facility level activity forecast.
- Terminal Area Forecast contains activity forecasts for each of 5,000 public use airports.

- Hub Forecasts are detailed forecasts of major air carrier airports and all other airports within major metropolitan areas.
- National Outage Data Base contains down time and repair time, by cause, for airway and air traffic control facilities (e.g., radars, landing and navigational aids, etc.).
- Air Carrier Aircraft Utilization and Propulsion Reliability System contains monthly reports from air carriers of the flight hours and number of aircraft by manufacturer and model for aircraft used in air carrier service for the month.
- Aircraft Registration System includes registrant's name and address, registration status, and aircraft description for each aircraft registered with FAA.

FEDERAL HIGHWAY ADMINISTRATION

Agency Mission

The roads and highways across the nation are used by more Americans more often than any other transportation system. The Federal Highway Administration (FHWA) oversees federal support for the facilities of greatest significance to the nation, including Interstate highways. The agency is concerned with the total operation and environment of highway systems, including highway and motor carrier safety. In administering its highway transportation programs, it gives full consideration to the impacts of highway development and travel; transportation needs; engineering and safety concerns; social, economic, and environmental effects; and project costs.

FHWA meets its data needs primarily through three offices. The Associate Administrator for Policy oversees the Office of Highway Information Management, which is responsible for collecting and publishing highway data from the states, managing related programs such as the Nationwide Personal Transportation Study, and coordinating statistical policy within FHWA. The Office of Policy Development, also under the Associate Administrator for Policy, manages census surveys of truck owners and business establishments. The Associate Administrator for motor carriers oversees the Office of Motor Carrier Information and Analysis, which is responsible for collecting and publishing safety data from motor carriers.

Current Data Programs

Data Collected Through States

Highway Performance Monitoring System

The Highway Performance Monitoring System (HPMS) is FHWA's on-going, integrated, annual data base, which consists of data on systems mileage, physical dimensions, usage, condition, performance, operating characteristics, and fatal and injury accidents. The HPMS data reported annually by each state consist of areawide data reports (e.g., areawide summaries of mileage, travel, accidents, travel activity by vehicle type, and population), universe data (23 data items that identify the nation's total public road mileage by systems, jurisdiction, and operation), and sample section data for approximately 110,000 sample sections of the nation's arterial and collector highway systems (55 additional pavement, improvements, geometric, traffic and capacity, environment, and supplemental items are reported for each sample section).

An equally important part of the overall HPMS is a set of analytical models that are used to assess overall system performance, project future capital needs, and evaluate future system performance under varying assumptions of standards, travel growth, and investment levels. These models, which convert data into useful information, constantly undergo refinement.

Traffic Characteristics

Three types of data on traffic characteristics are collected, processed, and analyzed:

- Traffic volumes from continuous automated traffic recorders are reported by the states and used to produce a monthly report on traffic volume trends that tracks changes in travel by state and functional class of highway. Hourly traffic volume data are reported monthly for about 3,000 stations.
- Travel by urban and rural functional systems is furnished annually as part of each state's HPMS submittal. These data are, for the most

part, based on traffic counts of the HPMS sections. On part of the HPMS samples, vehicles are classified to provide systemwide estimates of the proportion of travel by 13 vehicle types. Suggested traffic counting procedures are included in FHWA's traffic monitoring guide and in the HPMS field manual.

- Vehicle classification data collected at truck weigh stations and corresponding truck weight data are reported annually by the states. Axle weight data are converted to axle loadings, and a series of tables are produced for use in highway design, bridge design, pavement management, and truck enforcement programs. These data are collected by weigh-in-motion scales that provide the desired data without interrupting traffic flow. The processing of these data is done by microcomputer in a fully decentralized manner, which allows state users to analyze the data themselves while creating the data files for transmittal to FHWA.

Highway User and Usage Data

The state highway agencies report a series of data elements which form FHWA's highway statistics data base.

- FHWA collects motor-fuel use data from the states on a monthly basis. "Motor fuel" applies to gasoline and all other fuels under the purview of state motor-fuel tax laws. In addition to gasoline, motor fuel can include "special fuels," which comprise diesel fuel, liquified petroleum gases, and similar fuels when they are used to operate vehicles on highways, as well as gasohol and neat alcohol.
- The highway finance data base contains information on highway receipts, disbursements, debt status, and other financial information of federal, state, and local agencies. Information included is on intergovernmental transfers of funds from the federal government to states, and from states to local governments. Revenue data includes the amount and source of funds, including tax sources and debt. Expenditure data are broken down by capital and maintenance spending, spending for administration, police and safety purposes, and debt service.
- Motor vehicle registrations are reported to FHWA by major vehicle classes including automobiles, buses, trucks, and motorcycles. FHWA also supplements the data supplied by the states with information obtained from other sources. For instance, the Truck Inventory

and Use Survey conducted by the Bureau of the Census is one source that is used to achieve a level of uniformity in preparing various estimates and summaries.

- Each state and the District of Columbia administers its own driver licensing system and provides data to FHWA, which provides the basis for summaries of drivers licenses by type, sex, and age. This information is sometimes used as an exposure measure in the analysis of motor vehicle accidents and fatalities.

National Bridge Inventory

The National Bridge Inventory (NBI) is a mainframe computer system that includes detailed identification, classification, condition, appraisal, and proposed improvement information on more than 570,000 bridges on U.S. public roads. Bridge information is submitted by states in tape format at least annually and can be submitted as individual updates or as a replacement of the entire file. NBI data are accessible on line using a report generator that can produce several reports in various formats. NBI data are used to manage the bridge program and answer questions concerning any physical aspect of the bridge system.

Data Collected From States and Motor Carriers

Motor Carrier Management Information System

The Office of Motor Carriers (OMC) is responsible for overseeing the safety of the Interstate motor carrier fleet in the United States. The extensive data system that supports this effort is known as the Motor Carrier Management Information System (MCMIS). This is a computerized system that provides a comprehensive record of the safety performance of individual carriers for the use of OMC and authorized external organizations. The state portion of the MCMIS is known as SAFETYNET, which has and will continue to grow into a comprehensive data system for exchanging data among states and with the federal government. Information maintained in the MCMIS includes the following:

- Census: Carrier identification of the 200,000 interstate carriers, type and size of operation, commodities carried, as well as other characteristics of the operation are included.

- Review and Rating: Between 20,000 and 30,000 on-site reviews of carriers and hazardous material shippers are conducted annually by OMC field and state staff; reviews take place in the offices of the company and cover compliance with critical parts of the federal safety regulations.
- Inspections: Data are collected during the 500,000 roadside inspections of vehicles and drivers conducted annually; violations of regulations covering the driver and the vehicle, or specifically related to hazardous materials, are included.
- Accidents: Interstate motor carriers are required to file a standard accident report for accidents that meet or exceed federal reporting thresholds; in addition, states report the occurrence of all reportable truck accidents.

Highway Safety Information System

Highway Safety Information System (HSIS) is a new highway safety data base developed by FHWA and the University of North Carolina Highway Safety Research Center that provides detailed information linking accident, roadway, and traffic data for analyses of highway safety problems. The current system includes 5 years of data (1985–1989) from 5 states: Illinois, Maine, Michigan, Minnesota, and Utah. Detailed information on accident characteristics, roadway features, and traffic volumes are available from each of the five states. Additional data on roadway geometrics, intersections, and guardrail characteristics are available from one or more states.

Data Collected From Households and Truck Owners

Nationwide Personal Transportation Study

Nationwide Personal Transportation Study (NPTS) data are based on a nationally representative sample of households from which the amount and nature of personal travel by all modes is collected. NPTS has been conducted by the Bureau of the Census under contract with DOT in 1969, 1977, and 1983. FHWA has had the responsibility for the technical and administrative lead for DOT. Data collection for the most recent survey was completed in March 1991 under contract with the Research Triangle Institute of North Carolina. Substantial funding was provided by FHWA, the National Highway Traffic Safety Administra-

tion (NHTSA), and the Urban Mass Transportation Administration (UMTA). Results are used within the department to address national transportation policy issues, forecast future travel demand on various modes, analyze transit use, and calculate accident exposure rates. NPTS is the only authoritative nationwide source of information that allows a linkage between the characteristics of travel and the demographics of the household. Key indicators available from NPTS include trip generation rates per household; distribution of households by income and vehicle ownership; distribution of person trips by mode, purpose, and time of day; and average annual miles by driver age and sex. The main limitation of the survey is the extent of data on long-distance travel. In 1983, only one percent of the reported vehicle trips were trips of 75 mi or more (Klinger and Kuzmyak 1986, Vol. I, 1-7).

Nationwide Truck Activity and Commodity Survey

The Nationwide Truck Activity and Commodity Survey (NTACS) is conducted for FHWA by the Bureau of the Census as a follow-on to the Census Bureau's quinquennial Truck Inventory and Use Survey (TIUS). NTACS, which is funded by FHWA, the Federal Railroad Administration (FRA), and OST, measures detailed trip characteristics and other information for trucks on randomly sampled days, including items such as the city or county of each pickup and delivery, the type and weights of commodities carried, the types of highways used, amount of tolls paid, and the hours of the day that the vehicle was operated. The sample includes all trucks that were reported as carrying commodities over long distances in the 1987 TIUS, approximately half of the trucks that were reported as carrying commodities locally in 1987 TIUS, and a small portion of the remaining 1987 TIUS respondents.

Data Programs Under Development

Two data programs under development are the Passenger Flow Survey and the Commodity Flow Survey. The Passenger Flow Survey would provide comprehensive information on intercity passenger travel by all modes of transportation. Funding for planning and conducting the survey has been requested in DOT's fiscal year 1992 and 1993 budgets. The Volpe National Transportation Systems Center recently contracted for a preliminary design study to define survey objectives more

precisely, specify links with existing data programs such as NPTS, and examine data collection methods and options. Comprehensive survey design is planned for fiscal year 1992; data collection is anticipated to begin in fiscal year 1993. For a discussion of the Commodity Flow Survey see the section on the U.S. Bureau of the Census (p. 140).

NHTSA

Agency Mission

The mission of NHTSA is to improve the safety of motor vehicle transportation through the development of a systematic approach for the identification and elimination of motor vehicle and highway safety problems. The National Center for Statistics and Analysis (NCSA) serves this mission through the collection and analysis of motor vehicle crash data, the development of advanced technologies for data collection, and the creation of improved analysis techniques.

The data are used by NHTSA in support of research and the development of motor vehicle and highway safety policies and programs. The analysis of these data provide the scientific foundation for the agency's legal and regulatory actions. These data bases are also the primary source of information on motor vehicle and highway safety to other DOT agencies, especially FHWA, and to the auto manufacturing and insurance industries, state and local governments, and consumer interest groups.

Current Data Programs

NCSA develops and uses large-scale automated data bases to support problem identification, program planning, and program evaluation. The main crash data systems supported by the agency are the following:

Fatal Accident Reporting System

The Fatal Accident Reporting System (FARS) provides basic information on all highway traffic crashes in the United States in which one or more persons die of their injuries within 30 days of the accident.

FARS has been in operation since 1975, producing a census of records on more than 750,000 crash-induced fatalities. These data are

collected from the 50 states, the District of Columbia, and Puerto Rico. The data provide information on the demographics of the people involved, their injuries, the types of vehicles involved, the roadway and environment, alcohol involvement, restraint usage, and the history of each driver's previous violations and accidents.

National Accident Sampling System

The National Accident Sampling System (NASS) provides information from investigations of a statistical sample of police-reported accidents at all levels of injury severity. NASS consists of two components: the Crashworthiness Data System (CDS) and the General Estimates System (GES).

CDS currently comprises detailed investigations of real world highway crashes involving passenger cars, light trucks, and vans, which provide detailed information on the crashworthiness and occupant protection afforded by these vehicles.

Information is collected on the sequence of crash events, the severity of the crash, occupant injuries and their causes, and details of vehicle crash protection performance. These data provide national estimates of the scope and extent of highway crash injuries and causes. Occupant protection research and rulemaking depend on this data base for the detailed crash investigation-related data needed to understand crash injury mechanisms in a real world environment, and for countermeasure development and assessment.

GES currently comprises a uniform data file on a statistical sample of police-reported traffic crashes, which provides the basis for estimates of the general state of traffic safety. The current GES collects more than 50,000 cases per year for the preparation of general estimates of highway crash statistics. They are the only data the agency has that provide national estimates of traffic crash characteristics for all types of vehicles, and this is the only data base that provides these estimates with measurable reliability. In cooperation with FHWA, the NASS-GES system has been expanded to include data on heavy truck crashes to provide national estimates of heavy truck safety.

State Data Systems Program

This data program provides a large data base that consists of all police-reported accidents from a large number of states. This data base allows

for a wide variety of motor vehicle and highway safety issues to be assessed and currently contains data from 26 states.

The Crash Avoidance Research Data File is currently one of the main constituents of the State Data Systems Program. Its function is to collect and analyze data dealing with factors that contribute to crashes. Ancillary data bases, such as the Crashworthiness Data File, are being expanded and will be used in the statistical analyses of motor vehicle and highway safety issues.

The purpose of the State Data Systems Program is to build a large, high quality, statistically significant data base. Once the data collected by individual states is standardized and of sufficient quality, NCSA will be able to combine state data bases into a larger file that will model the national safety experience. When this occurs, estimates of the national highway safety experience can be made using state data files, eliminating the need for GES. The linkage of automated state traffic crash data with Emergency Medical Services (EMS) and hospital-collected trauma data will also enhance the quality of analysis dramatically. Currently, crash data bases at the state level traditionally provide only a general classification of the seriousness of a victim's injuries. Competent crashworthiness analyses often require more detailed descriptions of injuries (e.g., type of injuries and location at which they were sustained).

UMTA

Agency Mission

The mission of UMTA is to assist public and private mass transportation companies in the development of improved mass transportation facilities, equipment, techniques, and methods; encourage the planning and establishment of areawide urban mass transportation systems needed for economical and desirable urban development; and provide assistance to state and local governments in financing these systems.

Current Data Programs

UMTA currently supports the following major data bases.

Section 15

The Uniform System of Accounts and Records (Section 15) Reporting System was statutorily authorized as the basis for formula allocation of

UMTA's Grant-in-Aid programs in the early 1980s. The Section 15 Reporting System provides data on transit revenues by source; transit expenses by function and object class; nonfinancial operating data, including maintenance, employee counts, and service measures; and performance indicators, which relate measures of service outputs or use (e.g., vehicle revenue miles and passenger miles) to measures of resource inputs (e.g., revenue vehicles and labor hours).

Grants Management Information System

The Grants Management Information System provides comprehensive information on all grants and contracts that UMTA has made since the 1960s.

Financial Management System

The Financial Management System provides financial information on allotments, operating budget authority, and disbursements.

Other Data Activities

UMTA contracted with the Community Transportation Association of America in 1985 and again in 1989 to prepare a directory of rural (Section 18) and elderly and handicapped [Section 16(b)(2)] transit service providers that includes information about type of service offered, fleet size, and county(ies) in which the service operates.

UMTA, in cooperation with FHWA, has also periodically contributed to funding the National Personal Transportation Survey, for which the total cost is approximately $2 million.

UMTA also cooperates with FHWA and outside interested parties through the auspices of the Transportation Research Board on the Journey-to-Work portion of the decennial census and subsequent special tabulations that are included in the Census Transportation Planning Package. The data preparation, which is funded by FHWA and UMTA, is conducted by the Census Bureau under an Interagency Agreement.

FEDERAL RAILROAD ADMINISTRATION

Agency Mission

The mission of the Federal Railroad Administration (FRA) is to promulgate and enforce rail safety regulations, administer railroad finan-

cial assistance programs, conduct research and development in support of improved railroad safety and national rail transportation policy, provide for the rehabilitation of Northeast Corridor rail passenger service, and consolidate government support of rail transportation activities.

Current Data Programs

Carload Waybill Sample

The annual Carload Waybill Sample contains comprehensive detailed information provided by Class I freight railroads from a 1 percent sample of rail waybills to the Interstate Commerce Commission (ICC) about actual rail shipments, including commodities carried; railroads involved; origin, destination, and junction points; number of carloads; tons transported; and total revenues. ICC contracts with the Association of American Railroads to collect and process the data. FRA, which provides half of the funding for the waybill sample, uses a confidential version to produce periodic and ad hoc reports for use in traffic and competitive analyses in support of DOT policy development. A more aggregated sample, which does not reveal specific carriers or shipper locations, is available to the public.

Freight Commodity Statistics

This annual data base contains detailed commodity data filed with ICC by Class I railroads on tons and carloads of local, forwarded, received, overhead, and total traffic. Revenue for each commodity is also submitted. This source supports in-house analyses requiring traffic mix information for individual Class I railroads.

Princeton Transportation Network Model

FRA subscribes to this proprietary data base, owned by ALK Associates, Inc., to study rail movements in the United States. A typical FRA analysis involves flowing the waybill sample data over the network to examine nationwide hazardous materials transport by rail.

Railroad Inspection Reporting System

The Railroad Inspection Reporting System (RIRS) is used to monitor each FRA-performed inspection and record the nature of each defect uncovered and any follow-up action by the railroad to correct the deficiency. RIRS contains four data bases, each with its own forms and reports: (*a*) Signal, Track, and Motive Power (locomotives); (*b*) Equipment (cars); (*c*) Operating Practices; and (*d*) Hazardous Materials. Reports on inspector activity are generated monthly; other periodic reports summarize railroad noncompliance. FRA also produces ad hoc reports on specific elements of the inspection form by railroad or division.

Railroad Accident/Incident Reporting System

The Railroad Accident/Incident Reporting System includes all railroad accidents, grade-crossing accidents, railroad employee casualties, and any other injuries on railroad property. These data bases provide the basis for accident analyses and assessments as well as the annual *Accident/Incident Bulletin.*

Grade Crossing Inventory System

This system contains a record of every public and private crossing in the United States along with the accident history of each crossing. This data base is often used in conjunction with the Grade Crossing Accident Reporting System to generate Grade Crossing Accident Prediction reports requested by states and railroads.

Transborder Surface Transportation Data Project

Originally this project was to be funded by OST, FHWA, and FRA, but it is now funded solely by FRA. The objective is to determine the feasibility of coding the foreign trade data compiled by the U.S. Bureau of the Census from import and export documents to reflect the ground modes of transportation of U.S. exports and imports to and from Canada and Mexico. Currently, foreign trade data are only coded for vessel, air, and "other" modes of transportation.

MARITIME ADMINISTRATION

Agency Mission

The Maritime Administration (MARAD) administers programs to aid in the development, promotion, and operation of the U.S. merchant marine. Financial assistance programs are administered to support provision of essential services on U.S. flag carriers and construction of ships in U.S. shipyards. MARAD helps industry generate business for U.S. ships, conducts programs to promote development of efficient port facilities and intermodal transport, and promotes domestic shipping. It is also charged with maintaining the National Defense Reserve Fleet and its component Ready Reserve Force, and with organizing and directing emergency merchant ship operations.

Current Data Programs

The following is a brief summary of some of MARAD's principal data systems. It is not intended to represent an exhaustive inventory of all data bases maintained by MARAD but to indicate the scope and diversity of MARAD requirements, the various sources of such data, and the types of issues to which such data may be applied.

Maritime Statistical Information System

The Maritime Statistical Information System is a relational data base that combines MARAD's foreign trade, vessel, and port facilities data. The foreign trade subsystem is primarily Bureau of Census foreign trade data but also includes complete itineraries of more than 35,000 vessels worldwide—data purchased from Lloyd's Maritime Information Service. Foreign trade data obtained from the Bureau of Census includes information that identifies both the vessel and the operator, which is not available to the public and which Census collects only for MARAD and the Corps of Engineers. This data is used within MARAD as the basis for calculating subsidy rates and in support of a wide range of agency programs from operating subsidies and ship financing to bilateral trade negotiations.

The vessel subsystem contains detailed vessel characteristics, purchased from Lloyd's, on more than 35,000 merchant vessels worldwide and on the U.S. flag merchant fleet, obtained from the U.S.

Coast Guard and other sources. It contains information from a variety of sources on such items as container capacity, and whether the vessels are government or privately owned, were built with subsidy, have outstanding financing guarantees, or participate in the war risk binder program. The data form the basis for many MARAD publications and support, in some way, virtually all of MARAD's commercial and defense-related programs.

The ports subsystem contains MARAD's port facility inventory for inland river and ocean ports, which is collected through field surveys to supplement Corps of Engineers data. It supports MARAD's program to provide technical assistance in port and intermodal planning and operations to state and local port authorities, private industry, and foreign governments. It also supports MARAD's program to develop contingency plans for the use of ports and port facilities to meet defense needs.

Domestic Trade Data

MARAD obtains domestic trade data from the Corps of Engineers and produces a variety of reports in support of the agency's programs dealing with the inland waterways, Great Lakes, and domestic ocean trade—U.S. flag transportation segments that account for more than one billion tons of cargo each year.

Financial Reporting and Contract Surveillance

The Financial Reporting and Contract Surveillance program (FRACS) contains financial reports and vessel operating statements for the more than 200 companies that are required to submit statements to MARAD. FRACS also contains basic information about the companies and the MARAD contracts to which they are party. It enables MARAD to monitor financial and operating results on a timely basis and gives decision makers the benefits of an automated retrieval system.

Cargo Preference Data

To meet a congressional mandate to monitor compliance with cargo preference laws to maximize the use of U.S. flag vessels, MARAD

monitors the shipping activities of federal agencies, independent establishments, and government corporations. To perform this activity, MARAD maintains a computerized reporting system that processes information from more than 60,000 bills of lading annually.

Intermodal Equipment

MARAD compiles and publishes an annual Intermodal Equipment Inventory—a comprehensive statistical review and classification of equipment owned by American steamship and container leasing companies.

Maritime Labor

MARAD supports the training of merchant marine officers through operation of the U.S. Merchant Marine Academy and provision of financial assistance to six state maritime academies. MARAD also monitors maritime industry labor practices and policies in conjunction with national and international organizations. In support of these programs, MARAD collects and publishes data on maritime employment—seafaring, shipyard, and longshore. These data are used extensively in developing training programs, making policy regarding academy and state school support, and defense planning.

Sealift Planning

In connection with its national security responsibilities, MARAD maintains data bases to evaluate U.S. shipbuilding and repair capabilities and forecast U.S.-flag and U.S.-owned foreign-flag fleets.

U.S. COAST GUARD

Agency Mission

The mission of the U.S. Coast Guard (USCG) is to enforce or assist in the enforcement of all applicable federal laws on the high seas and waters subject to the jurisdiction of the United States; administer laws, and promulgate and enforce regulations for the promotion of safety of life and property on the high seas and on waters subject to U.S.

jurisdiction, covering all matters not specifically delegated by law to some other executive department or reserved to the states; develop, establish, maintain, operate, and conduct, with due regard to the requirements of national defense, aids to maritime navigation, icebreaking facilities, oceanographic research, and rescue facilities for the promotion of safety on and over the high seas and waters subject to U.S. jurisdiction; maintain a state of readiness to function as a specialized service in the Navy in time of war; and establish and maintain a coordinated environmental program and a comprehensive ports and waterways system, including all aspects of marine transportation.

Current Data Programs

Recreational Boating Safety System

The Recreational Boating Safety data base contains reports on recreational boating accidents that occur in state waters or in waters under joint state and federal control that result in loss of life, injury requiring medical attention beyond first aid, damage to the vessel and other property exceeding $200, or complete loss of the vessel. The accident reports provide information on the time of day and year of the incident, environmental conditions, type of incident, and cause. Data are also collected on boat registrations, which provide a basis on which to calculate accident and fatality rates.

Casualty Maintenance System

The Casualty Maintenance System (CASMAIN) is a data base administered by the Marine Investigation Division that contains data on commercial vessel casualties, including injuries and deaths. A typical report includes information on case numbers, vessel identification numbers (VINS), casualty coordinates, vessel names and types, gross tonnage, the primary nature and cause of the accident, weather-related information, and reported damage.

CASMAIN queries are solicited from all facets of marine industry (i.e., associations, unions, vessel owners, operators, and manufacturers. Users include Congress; local, state, and federal government agencies; financial institutions; universities; medical research facilities; settlement attorneys; salvage operators; and foreign embassies.

Seamen Documentation and Records System

The Seamen Documentation System includes the marine licensing program and is located in the Office of Marine Safety, Security and Environmental Protection. The system, among its other functions, maintains files of shipping articles and master lists for reference in documenting service time for mariners and providing service records to mariners, the maritime community, and other interested parties. It also maintains records of every mariner's service and other related information. This currently is a manual system that is projected for automation by 1992.

Search and Rescue Management Information System

The Search and Rescue Management Information System is administered by the Office of Navigation Safety and Waterways Services, which provides for the collection, storage, and retrieval of information on the Coast Guard's responses to search and rescue (SAR) incidents. The primary use of the system is to derive a picture of the demands made of USCG by SAR clientele and project these demands to measure unit workloads, determine resource use and needs, justify budget requests, and analyze system operations for potential savings.

Marine Safety Information System

The Marine Safety Information System (MSIS) is a data system that supports USCG marine safety regulatory programs. The system tracks inspections of U.S. and foreign vessels (including their cargos and equipment), offshore oil and gas facilities, and port facilities (e.g., cargo docks) for such safety-related items as presence of hazardous materials and adequacy of fire-fighting equipment. Vessel inspection and violation histories are used, among other purposes, to assist in USCG boarding decisions. MSIS also records and tracks casualty information for marine accidents by vessel; full investigative reports are contained in CASMAIN, although the two systems will soon be linked electronically. Finally, MSIS tracks information about pollution incidents, including the parties and vessels involved and the costs.

Marine Pollution Retrieval System

The Marine Pollution Retrieval System (MPRS) and its predecessor, the Pollution Incident Reporting System, were designed for the Marine

Environmental Response Program to generate a data base of pollution incidents. MPRS reports pollution incidents that occur within all navigable waters of the United States. The data base tracks the number of pollution incidents; the nature, cause, extent, location, and time of the spill; and the parties involved. Annual summary data are prepared and published periodically in a report entitled *Polluting Incidents In and Around U.S. Waters*.

SAINT LAWRENCE SEAWAY DEVELOPMENT CORPORATION

Agency Mission

The Saint Lawrence Seaway Development Corporation (SLSDC), a wholly government-owned enterprise, is responsible for the development, operation, and maintenance of the St. Lawrence Seaway between the port of Montreal and Lake Erie within the territorial limits of the United States. It is the function of the seaway corporation to provide a safe, efficient, and effective water artery of maritime commerce, both in peacetime and in time of national emergency.

Statistical activities of the SLSDC are used to support these responsibilities. Its data collection efforts are specific to the seaway, and focus on the flow of passengers and cargo, traffic control, aids to navigation, and safety.

Current Data Programs

SLSDC collects data on the vessels, passengers, and cargo transiting the St. Lawrence Seaway.

U.S. BUREAU OF THE CENSUS

Overview and Data Collection Mandate

The Census Bureau is a general purpose statistical agency that collects, tabulates, and publishes a wide variety of data about the people and the economy of the nation. Over the years the Census Bureau has conducted a limited number of transportation statistics programs and currently is significantly expanding transportation industry statistics to meet increased data user needs.

The Bureau of the Census is required by law to collect and publish general purpose data on the state of the economy and the population through censuses and sample surveys. The majority of the data are used directly by other agencies as input to their programs or to supplement other data collections to meet specialized needs such as price indexes, productivity measures, and economic development. The data collection authorization of the census covers all sectors of the economy, except when a regulatory organization requires data collection to complete its own mission. Duplicative data collection is not allowed, and therefore regulatory data is often used for general economic and policy decisions. The bureau serves as the data collecting and compiling agent for other government agencies.

Current Transportation-Related Data Programs

Quinquennial Economic Census Programs

The Census of Transportation, conducted for the years 1987 and 1992, consists of two parts: establishment-based universe statistics for selected transportation industries and TIUS.

1987 and 1992 Statistics of Transportation Establishments

The transportation establishment statistics correspond to those collected for other kinds of business in other economic censuses. They provide data on general finances and employment and on a number of establishments. They cover only three of the eight major groups in the transportation-related part of the Standard Industrial Classification (SIC) system—42: Trucking and Warehousing, 44: Water Transportation, and 47: Transportation Services.

For many of the industries in the transportation census (e.g., trucking), the establishments have activities, workers, and equipment that may move from place to place. For the census, an establishment is a relatively permanent office, shop, station, terminal, or warehouse. Census figures for states and metropolitan areas reflect permanent establishment location and not necessarily the location where the trucking or other activities take place.

The establishment counted in the Census of Transportation offers services to the general public or to other business enterprises. Establishments that furnish similar services (e.g., warehousing) only to

other establishments of the same company are classified as auxiliary to the other units of the company that they serve. Data for auxiliaries are presented in a report issued as part of the 1987 Enterprise Statistics series, but not in the Census of Transportation. The census excludes firms that do not have paid employees. Thus, for example, many independent truckers are not included in the 1987 establishment statistics.

TIUS 1982, 1987, 1992

TIUS, taken every 5 years as part of the economic census program, reports on the physical characteristics and operational use of the nation's private and commercial trucks. Unlike other economic census programs, the coverage of TIUS cuts across SIC classifications and even includes personal vehicles, although vehicles owned by federal, state, and local government agencies are not covered. Some private or commercially owned vehicles that do not have to be licensed (e.g., trucks used exclusively on private property) are also excluded. The 1987 TIUS includes physical characteristics of the nation's private trucking fleet, such as vehicle type, gross weight, type and size of engine, type of transmission and braking system, power steering, fuel conversion, air conditioning, type and size of body, power axles, axle arrangements of trailer units, and cab type. The survey also includes operational characteristics, such as base of operation; number of trucks, truck-tractors, and trailers operated from base of operation; area of operations; vehicle miles; miles per gallon; use of vehicle; and type of commodities carried (including hazardous materials).

For 1987, about 135,000 private and commercial trucks were sampled from approximately 44.8 million state vehicle registrations.

Census of Manufactures 1982, 1987, 1992

This census includes establishment coverage of more than 10,000 transportation equipment manufacturers. Coverage includes all eighteen 4-digit industries of equipment manufacturers in SIC 37, from guided-missile to recreational-camper manufacturers. Data include employment, wages, value of shipments, value added, capital expenditures, operating expenses, assets, and inventories.

Census of Governments 1982, 1987, 1992

Coverage extends from the federal government and the 50 state governments to some 83,000 units of local government—counties, cities, towns, school districts, and special districts. Data collected include full- and part-time employment and payrolls; revenues by type and sources, expenditure by character, object, and function (including an array of transportation-related functions); indebtedness by type and purpose; and assets held by the government as cash or investments in securities.

Census of Construction 1982, 1987, 1992

Coverage includes transportation-related construction establishments, such as those primarily engaged in highway, street, bridge, and tunnel construction. Data include the value of work done, assets, expenses, capital expenditures, and employment.

Census of Agriculture 1982, 1987, 1992

A universe count of farms and farm production by small geographic location is provided by this census. Data highlight the county of agricultural production (which is typically transported by truck, rail, or water) plus expenses and assets, including fuel costs and trucks used.

Enterprise Statistics 1982, 1987, 1992

The Enterprise Statistics program regroups census data for establishments under common ownership or control to show various economic characteristics of the owning or controlling firms. This program also yields separate data about auxiliary establishments. An auxiliary establishment is one whose employees are primarily engaged in performing supportive services, such as trucking and warehousing, for other establishments of the same company instead of for the general public or other business firms. Information available includes the number of auxiliaries and payroll, the number of employees engaged in several different types of service, sales or receipts, end-of-year inventories, rental payments, selected expense data, and so forth.

Decennial Demographic Census

Questions on the means of transportation people use to get to work by geographic location of their work place have been included in the decennial Census of Population and Housing since 1960. In 1980, items on travel time to work and carpool occupancy during the work trip were added. In 1990 information on the time at which individuals left home to go to work was collected for the first time in the Census of Population and Housing. Data on these topics are made available in printed reports and on computer tapes for geographic areas such as census tracts, places, counties, metropolitan areas, and states.

Existing Economic Survey Programs

- Motor Freight Transportation and Warehousing Survey is an annual survey based on a sample of 1,500 firms that represent all employer firms with one or more establishments that are primarily engaged in providing for-hire commercial motor freight transportation and warehousing services. This includes firms that furnish local or long-distance trucking or transfer services and those that store farm products, furniture and other household goods, or commercial goods of any nature. The survey provides about 50 data items on operating revenues and operating expenses, plus inventories of revenue-generating equipment for establishments in SIC 42 for the United States. Comparable statistics are shown for the previous year along with year-to-year percentage changes. Publication is released about 9 months after the period of reference.
- NTACS is a DOT-sponsored follow-on survey to the quinquennial TIUS, and has been designed to obtain operational characteristics and activity patterns of trucks by collecting trip-specific information primarily from commodity-carrying trucks. It provides essential information for the analyses of truck size and weight issues, highway user charges, safety issues, energy and environmental constraints, proposed investments in new roads and technology, hazardous materials transport, and other aspects of the Federal-Aid Highway Program. Questions on NTACS also provide linkages between TIUS and other existing sources of truck-related information.
- Annual Survey of Manufactures provides data on domestic manufacturers' production of transportation equipment, including value of

shipments, expenses, and other key measures for 18 transportation equipment manufacturing industries.

- Annual Government Finance Surveys provide coverage of the federal government, 50 state governments, and a sample of some 22,000 local governments—counties, cities, towns, school districts, and special districts. Data collected include full- and part-time employment and payrolls; revenues by type and source, including transportation-related sources (e.g., motor fuel taxes, toll charges); expenditure by character, object, and function (including an array of transportation-related functions); indebtedness by type and purpose; and assets held by the government as cash or investments in securities.
- Surveys of Transportation Equipment Manufacturing provide national estimates of domestic production of aerospace equipment, aircraft, and truck trailers.
- County Business Patterns is an annual series of national and state publications presenting county-level data on the number of establishments with paid employees, total employment, and payroll on an establishment basis, with economic activity classification reflecting the principal activity at each individual location. The coverage includes about 45 transportation industries in each of more than 3,000 counties.
- Foreign Trade Statistics provide a monthly census of U.S. export and import transactions on the basis of official documents that shippers and receivers must file with the U.S. Customs Service for each shipment. These figures reflect the flow of merchandise, but not such intangibles as services and financial commitments. The trade figures trace commodity movements out of and into U.S. Customs jurisdictions. Key variables in foreign trade reports are export value calculated free alongside ship (f.a.s.), import value, specific commodities shipped, and foreign country of origin or destination. Additional variables shown selectively include SIC-based product code, methods of transportation (e.g., air, sea, or land), U.S. state of origin or destination, U.S. and foreign ports, quantities shipped, and weight for air and sea shipments.
- Plant and Equipment Expenditure Survey is a quarterly publication of transportation equipment manufacturers that provides investment information for manufacturing and transportation service firms.
- Quarterly Financial Report contains up-to-date aggregate statistics on the financial results and position of U.S. corporations. The report presents estimated statements of income and retained earnings, balance sheets, and related financial and operating ratios for the transportation

equipment industry, including detailed information on motor vehicles and motor vehicle equipment, aircraft, and parts.

Existing Demographic Surveys

- Information has been collected in the American Housing Survey (AHS) since the mid-1970s on means of transportation to work, travel time to work, and distance to work. Other data items, including information on the geographic location of the work place, have been collected periodically from both the national sample and the individual metropolitan area samples of AHS. Data are available in printed reports, public-use microdata files, and unpublished tabulations for selected large cities and counties, and for the nation.
- Transportation expenses are collected as part of the Consumer Expenditure Quarterly Interview Survey, which provides information on how various groups of U.S. consumers spend. The survey data include large expenditures, such as automobiles, and expenditures that occur on a regular basis, such as gasoline and insurance premiums.

Approved and Budgeted Programs Under Development

The expanded 1992 Census of Transportation will present significantly more transportation establishment statistics on revenues, payroll, and employment by varied transportation classifications. It will provide these data for 43 4-digit industries in the following major SIC groups.

SIC Major Group	*Title*
41	Local and Suburban Transit and Interurban Highway Passenger Transportation
42	Motor Freight Transportation and Warehousing
44	Water Transportation
45	Transportation by Air (excludes large certificated passenger air carriers)
46	Pipelines, except Natural Gas
47	Transportation Services

This represents an expansion in the scope of the Transportation Census for 15 industries in major groups 41, 45, and 46, incorporating

more than 24,000 additional establishments with more than 860,000 employees. General financial and employment data, and number of establishments will be provided.

The questionnaire and collection methodology for these industries were tested as part of the 1989 pretest. Review of the data collected on these questionnaires and the accompanying evaluation forms should provide the information needed to finalize the coverage and questionnaire design for these industries in 1992.

Additionally, collection of data for the railroad industry and large certificated passenger air carriers is under consideration. Review of the data available from other government agencies (ICC and DOT, respectively) and the reportability of requested data and information from the pretest will determine whether these industries should be within the scope of the 1992 Census.

Plans are to publish data from the 1992 Census on a national basis and, where not prohibited by confidentiality restrictions, for selected states and metropolitan statistical areas. Publication plans for 1992 include the release of summary data for nonemployers in transportation industries for the first time.

Future Planned Surveys

Charter, Rural, Intercity Bus Survey

This annual survey would provide a complete enumeration of approximately 2,000 firms offering intercity, rural, or charter bus transportation services. Estimates of annual dollar volume for intercity and charter bus activities range from $5 to $8 billion. The 1982 Bus Regulatory Reform Act seriously reduced the amount of data on intercity bus activity. Although intercity scheduled service has continued to decline, charter and tour ridership is growing. More than 40 data items on revenues and expenses are planned. If approved, the survey, covering calendar year 1992 activities, will be published in December 1993.

Transportation Services Survey

This annual sample survey would cover all employer establishments from a universe of 34,000 establishments providing transportation services (SIC 47). Estimates of dollar volume for services incidental to transportation range from $12 to $14 billion annually.

Regulatory reform has had a profound effect on the structure of freight transportation as traditional lines of delineation between arrangers of freight transportation have become blurred. All public data collection on freight forwarding ceased in 1980. About 35 data items on detailed revenues and expenses are planned. If approved, the survey, covering calendar year 1992 activities, will be published in December 1993.

Water Transportation Survey

All employer firms providing water transportation services would be covered in this annual sample survey. The industry consists of 7,500 establishments with estimated revenues of $7 to $9 billion.

Existing data sources deal almost exclusively with the physical characteristics of the system—vessels, waterways, and port facilities of the industries—or with commodity movements. The passenger transportation segment of this industry is one of the fastest-growing components of the travel sector. About 40 detailed data items on revenues and expenses are planned. If approved, the survey, covering calendar year 1992 activities, will be published in December 1993.

Proposed Joint Projects

State and Local Government Transportation Survey

This proposed survey would fill an important need for information about the resources state and local governments devote to the provision of transportation infrastructure and services. The survey would include all aspects of government transportation services, including highways, water transportation, air transportation, and transit operations. The data would emphasize the financial and personnel resources that state and local governments provide to construct, maintain, and operate these services.

The existing data on state and local government transportation services is fragmented by the diffuse nature of federal, state, and local government organizations. The Census Bureau's data collection programs on state and local government finances and employment provide an ideal base for establishing a comprehensive transportation information system (i.e., uniform time frame, definitions, data classification, and data collection methods).

This would be a voluntary survey of all state governments and a sample of individual local governments—counties, municipalities, townships, school districts, and special districts. The financial data would cover the entire range of financial activities: revenues (motor fuel taxes, transit charges, federal revenues); expenditures (highway construction, transit system current operations); indebtedness (types of debt financing for airports and highways); and gross assets (including highway trust funds). For comparative purposes, the employment data, showing number of employees and payroll, would cover the same functional areas as the expenditure information. In addition, information would be collected from school systems about the costs related to transportation of pupils.

In summary, this survey would provide, for the first time, comprehensive state and local financial data on transportation activities. New consistent data would be published annually for the following categories: (*a*) gross value of transportation assets by governmental unit by transportation function and (*b*) specific relationship of governmental financing along with the actual expenditures (e.g., federal government contribution and debt financing by transportation function and purpose). Information on funding sources will include tax levies, debt issues, fees charged, and miscellaneous revenues.

1993 Commodity Flow Survey

The proposed commodity flow survey of shippers would measure the flow of goods from origin to destination within the United States. The weight and value of about 18 million sampled shipments would be collected. Other information collected for these sampled shipments would be the mode of transport, and commodity code (5-digit).

The survey would include establishments classified in manufacturing, minerals and mining, wholesale, and other selected industries. The survey would be conducted by the Census Bureau in 1993 with major funding provided by DOT. The information would be used by DOT to evaluate truck size and weight limits, user fees, cost allocation, energy and environmental constraints, economic viability of competing modes, hazardous materials transport, intermodal programs to improve economic productivity and international competitiveness, and other key transportation issues.

Bus and Government Vehicle Survey

Little is known about the use of the highway system by buses and government-owned vehicles. An estimated two million of these vehicles are currently in use, and they certainly could have an important impact on highway condition. In addition, complete information on bus and government vehicle road use is needed for accurate forecasting of highway capacity and investment requirements.

The Census Bureau and DOT are evaluating existing data sources in these areas and formulating a proposal for efficiently measuring and monitoring annual changes.

U.S. ARMY CORPS OF ENGINEERS

Agency Mission

The United States Army Corps of Engineers (USACE) serves as the Army's real property manager, performing the full cycle of real property activities (requirements, programming, acquisition, operation, maintenance, and disposal); manages and executes engineering, construction, and real estate programs for the Army and the U.S. Air Force; and performs research and development in support of these programs. USACE manages and executes Civil Works Programs, which include research and development, planning, design, construction, operation and maintenance, and real estate activities related to rivers, harbors, and waterways; and administers laws for protection and preservation of navigable waters and related resources such as wetlands. It also assists in recovery from natural disasters.

Through its Navigation Data Center, USACE collects, processes, manages, and disseminates a variety of statistical data relating to foreign and domestic waterborne commerce, vessel and port facility descriptions, and navigation lockages. The reports include annual statistical tabulations of domestic and foreign commodity movements on U.S. waterways and within ports, an annual directory of operating domestic vessels, periodic revisions of port facility descriptions, quarterly detailed statistics for each Corps of Engineers-operated lock, and dredging statistics. Information is provided both in published reports and on data processing software.

The Navigation Data Center provides coordination of navigation information within USACE, the U.S. Department of Defense, all federal and nonfederal agencies, and with private partners and the general public, to ensure effective data collection and dissemination strategies. The center consists of the Waterborne Commerce Statistics Center, the Port Facilities Branch, and two teams covering the lock performance monitoring system and dredging statistics.

Current Data Programs

Waterborne Commerce and Vessel Statistics

Waterborne Commerce of the United States (WCUS), Parts 1-5, contains statistics on the commercial movement of foreign and domestic cargo available in both hard copy and computer tape. The Public Domain Data Base of WCUS contains aggregated information on waterborne commodity movements by 26 geographical areas, available in both hard copy and computer tape. The Principal Ports Tonnage Report ranks U.S. ports for a calendar year by total tons, domestic and foreign. The State Tonnage Report contains total waterborne commerce by state. The Transportation Lines of the U.S. lists vessel operators and their addresses, type and physical description of vessels, principal service, location, and commodity served. The Navigation Data Center handles special requests for commerce and vessel statistics, which are not contained in standard products, on a case-by-case basis.

Port Facilities

These data consist of the physical and intermodal characteristics of the coastal, Great Lakes, and inland ports in the United States. Fifty-six Port Series Reports are published at intervals of approximately 7 years, covering more than 200 individual port areas. Reports consist of complete descriptions of a port area's waterfront facilities, including detailed information on berthing accommodations, petroleum and bulk handling terminals, grain elevators, warehouses, cranes, transit sheds, marine repair plants, fleeting areas, and floating equipment. A special 1988 report, *Summary of Commodity Handling Terminals of the United States Inland Waterways*, groups the various terminals by type

of commodity handled and includes location, berthing length, cargo direction, operating rate, and storage capacity for each facility.

Lock Performance Monitoring

Lock Performance Monitoring (LPM) data consist of descriptions of the traffic through locks on the inland waterway system as well as the physical aspects of lockages. Specifically, data is collected on vessel name, number, river direction, number of cuts, lockage, entry and exit type, arrival time, lockage time, and factors that may have interfered with the lockage. Vessel data include vessel name and number, flotation dimensions, number of passengers, barge types, number, and type and tonnage. The LPM system produces several reports, including a semiannual *Summary of Lock Statistics* and an *Overview of the Lock Performance Monitoring System.*

Dredging Statistics

Dredging statistics include data on bid schedules, location of contact, dredge type, and cubic yards. The Navigation Data Center is responsible for defining and developing a new system during fiscal years 1991 and 1992 to provide both industry and the corps with a more current and accurate dredging data program.

INTERSTATE COMMERCE COMMISSION

Agency Mission

The Interstate Commerce Commission (ICC) regulates interstate surface transportation, including trains, trucks, buses, water carriers, freight forwarders, transportation brokers, and a coal slurry pipeline. The regulatory laws vary depending on the type of transportation; however, they generally cover certification of carriers seeking to provide transportation for the public and their rates, adequacy of service, purchases, and mergers. The commission ensures that the carriers it regulates will provide the public with rates and services that are fair and reasonable.

With enactment of the Railroad Revitalization and Regulatory Reform Act of 1976, the commission's statutory mandate was altered to provide for less regulation over rail freight rates and practices. This

fundamental shift in national transportation policy was reinforced by enactment of the Motor Carrier Act of 1980, the Staggers Rail Act of 1980, the Household Goods Transportation Act of 1980, and the Bus Regulatory Reform Act of 1982. These measures provided for a sharply reduced federal role in regulating the trucking, railroad, and bus industries.

Although ICC statistical activities have been reduced, the agency still produces a number of important statistical products. The areas of coverage include railroads and motor carriers of property and passengers (i.e., trucks and buses).

In each modal area the industry is divided into classes based on revenues. Trucking and intercity bus carriers with more than $5 million in earnings are categorized as Class 1, those with between $5 million and $1 million as Class 2, and those with less than $1 million as Class 3. The revenue thresholds were established in 1980 and are adjusted for inflation each year.

Current Data Programs

Annual Reports to Congress

The commission has provided an annual report to Congress for more than 100 years. These extensive reports draw on the regulatory activities and statistical reports received by the commission and provide a useful summary of the status of regulated transportation.

Transport Statistics in the United States

This report, published annually, provides summary statistics for Class 1 rail and motor carriers, including general balance sheet and financial data, operating income and expenses, and operating statistics. Some information on physical equipment, such as track and operating equipment, is also included.

Motor Carrier of Property Quarterly Freight Revenue Report Form

The Quarterly Freight Revenue (QFR) schedule, substantially reduced from its prederegulation length, covers major financial and operating statistics for trucking firms. Reporting is required on a quarterly and

cumulative annual basis. Only the carriers identified as Class 1 or 2 are required to provide significant reporting in the trucking sector. Reporting carriers number approximately 2,000 in contrast with more than 42,000 nonreporting carriers. Class 3 and exempt carriers are only required to provide identification information and revenue data sufficient for classification purposes.

The individual carrier reports are available for inspection in a public reference room. Each quarter, the commission's Office of Economics produces a brief release citing the top 100 carriers and reporting selected earnings data. These are published under the titles *Large Class 1 Motor Carriers of Property Selected Earnings Data* and *Large Class 1 Household Carriers Selected Earnings Data.* Far more detailed financial and operating statistics from data filed in QFR are provided for a fee by the American Trucking Associations in the *Motor Carrier Quarterly Report: Financial and Operating Statistics.*

Motor Carrier of Passengers Quarterly and Annual Report

Motor carriers of passengers (i.e., intercity bus carriers) complete a substantially abbreviated version of the QFR financial and operating schedule, called MP-1. Only the Class 1 carriers are obligated to provide the required report in the bus sector. The Class 1 intercity bus carriers number about 30 of more than 3,000 bus carriers. Reporting firms provide a mix of scheduled service, tour and charter operations, school bus, and even local transit services. One firm, Greyhound, generates most of the industry's Class 1 revenues. The ICC Office of Economics provides a parallel quarterly release to the trucking report for the top ten bus carriers, *Large Motor Carriers of Passengers Selected Earnings Data.*

Quarterly Report of Railroad Revenues, Expenses and Income

Rail reporting follows a format similar to the motor carrier system, but, because of the nature of the industry structure, Class 1 carriers represent almost all of the industry's activity. Class 1 carriers are defined as those with revenues above a certain threshold ($93.5 million in 1989); the dividing line for Class 2 and 3 carriers is at $18.6 million. Only those in Class 1 are required to report quarterly and annual financial and operating information. Class 1 carriers numbered

only 16 in 1990 but accounted for more than 90 percent of total industry revenue. There are approximately 500 non-Class 1 carriers.

Report of Railroad Employment Class 1 Line-Haul Railroads and Wage Statistics of Class 1 Railroads

Because the rail industry does not participate in the social security system of the United States, ICC is responsible for the collection of monthly and annual data on employment and wages for Class 1 railroads. These data are provided to the Bureau of Labor Statistics for such purposes as compiling employment statistics of the U.S., the unemployment rate, and the calculation of productivity measures.

Rail Waybill Statistics

In addition to financial and operating statistical reporting, ICC, in a jointly funded activity with FRA, contracts with the Association of American Railroads (AAR) to produce the Rail Waybill Statistics, which reports on rail origin-destination movements by commodity, based on a sample of shipping documents and computer files. The report is published by FRA (see p. 124).

U.S. DEPARTMENT OF AGRICULTURE

Agency Mission

The mission of the U.S. Department of Agriculture (USDA) is to improve and maintain farm income and develop and expand markets abroad for agricultural products. The department works to enhance the environment and maintain U.S. production capacity by helping landowners protect soil, water, forests, and other natural resources. Rural development, credit, conservation, and research programs are also part of the department's mission. Finally, the department safeguards and ensures standards of quality in the daily food supply through inspection and grading services.

The Transportation and Marketing Division (TMD) of USDA's Agricultural Marketing Service (AMS) helps develop an efficient agricultural and rural transportation system by providing research, technical assistance, and leadership in developing transportation policy and programs within USDA. In doing so, TMD draws on a variety of

data sources in both the public and private sectors. TMD is both a data user and a data gatherer.

Current Data Programs

Ocean Grain Freight Rates

TMD has electronically compiled more than 5 years of grain freight rates from the weekly publication *Maritime Research*. Both U.S. and foreign origins and destinations are included, along with shipper, volume, rate, and other information. The information is used to determine the U.S. competitive position in worldwide grain markets and estimate USDA export commodity programming levels.

Trucking

TMD monitors trends in agricultural trucking. However, because unprocessed agricultural commodities moving by truck are generally unregulated, the lack of reporting requirements causes a major shortfall in reliable data. Information on rates, tonnages, the number of carriers, and flow patterns is generally nonexistent. Through records kept by the AMS market news reporters, data are available on fruit and vegetable shipments and receipts at major markets. TMD also calculates per-mile costs for exempt owner-operators of truck fleets.

Waterways

TMD collects information on grain flows through seven strategic locks on the Mississippi River system. Although the information is available from USACE, timeliness and accuracy are sometimes an issue. TMD is interested in grain traffic by type of grain, whereas the USACE data sometimes do not distinguish among the various grain types.

Rail

TMD uses a waybill bill sample from the ICC to determine grain movements by rail. However, certain use restrictions are placed on these data, which limit their utility in analyzing the movement of agricultural goods.

PRIVATE DATA SOURCES

The private sector also collects national data on the transportation system primarily through surveys by industry associations or by compilation and analysis of public data. The following is an illustrative but not comprehensive list of some of the major private transportation-related data sources organized by mode.[1]

Trucking

- FREIGHTSCAN, a data base that is available from Data Resources Inc., provides annual information on commodity flows by product and mode by origin and destination pair for states and Bureau of Economic Analysis areas. Data are available on surface transportation modes only.
- TRANSEARCH, available from Reebie Associates, also provides annual data on U.S. domestic freight traffic movements by market area, commodity, and mode of transport. The main focus is on surface transportation. TRANSEARCH also provides detailed information on U.S. international trade flows in three separate data bases. FREIGHT LOCATOR, a complementary data base, identifies and profiles transportation requirements of plants accounting for 90 percent of U.S. manufacturing output.
- TRAM, Inc. provides information on motor carriers from an in-depth survey of truck drivers conducted at 30 truck stops along high-density corridors in the United States and Canada. Information is collected on driver demographics, type of truck, company, and characteristics of the haul, such as trip origin and destination, commodities hauled, and truck weight.

Rail

- Railinc Corporation, a wholly owned, for-profit subsidiary of AAR, manages several large rail data bases. The Universal Machine Language Equipment Register data base contains the characteristics of all rail cars operating in the United States, including information on age of equipment, number of locomotives in service by type of unit, number of freight cars in service by type, average freight car capacity, and aggregate capacity. The Train II data base provides detailed reports on all rail car movements.

- Profiles of U.S. Railroads is a survey of non-Class 1 railroads (i.e., regional and short line railroads), also conducted by AAR. Data are provided on revenues, employment, miles of road operated, ownership, commodities carried, and average length of haul.
- ALK Associates, Inc. Transportation Network Model enhances the rail waybill sample by adding origin-destination and other rate data to track rail flows by means of a digitized rail network program. ALK, a subcontractor to AAR, also has a digitized highway network with the capacity to do traffic analyses such as hazmat routings.

Aviation

- Regional Airline Association Survey provides data on passenger enplanements, revenue passenger miles (total and average per carrier), number of airports served, average trip length, commuter aircraft capacity (i.e., seats per aircraft and fleet flying hours), and capacity utilization (i.e., hours per aircraft).
- Air Transport Association (ATA) of America Survey is a survey of airline passengers conducted annually by the Gallup Corporation for ATA that includes demographic information, data on trip purpose, and frequency of air travel.
- International Air Transport Association provides origin-destination statistics on international flights and air freight data between regional pairs. It also provides World Air Transport Statistics, including operating and financial statistics, safety, traffic, and capacity data on Atlantic and inter-European routes.
- Future Aviation Professionals of America provides data on commercial flight crews, including information on new hires and retirement age projections.

Water

The Port Import Export Reporting System, managed by the *Journal of Commerce*, provides information on maritime foreign trade data by shipper on origin or destination of inland shipments, overseas origin or destination data, commodity detail, volume shipped, and price data. Data sources are the ocean bill of lading for exports and the inward foreign manifest for imports.

Pipeline

- *Oil and Gas Journal* compiles source data from the Federal Energy Regulatory Commission on miles of petroleum pipeline by type, operating revenue, and net income for interstate petroleum pipelines.
- Association of Oil Pipelines provides annual data on ton-miles of petroleum and refined products transported.
- American Gas Association provides data on U.S. natural gas pipeline mileage by type and financial data for gas pipeline companies.
- Gas Research Institute provides long-range projections of geographic production and consumption patterns of natural gas.

Multimodal

- *Transportation in America*, a publication now published by the Eno Foundation for Transportation, Inc., provides multimodal trend data drawn from a multitude of public and private data sources supplemented by estimates of missing data.
- *U.S. Travel Data Center National Travel Survey*, a monthly telephone survey of 1,500 households, first conducted by the U.S. Travel Data Center in 1979 to provide more current data between DOT's National Travel Surveys, provides information on trip characteristics, including mode, purpose, distance, and duration for all travel greater than 100 mi from home as well as demographic data on the traveler.

NOTE

1. Information for this section was drawn largely from two articles on freight (Anderson 1990) and passenger (Cook 1990) data sources, supplemented by telephone follow-ups with selected providers.

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ABBREVIATION

DOT U.S. Department of Transportation

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Appendix B
New Technologies for Transportation Data Collection and Analysis: Opportunities and Applications

ALAN E. PISARSKI

Transportation data collection is a time-consuming and expensive undertaking. This, in part, explains the lack of comprehensive transportation data collection by the federal government. Obtaining adequate national coverage of almost any subject area of transportation may well cost millions of dollars. Similarly, time requirements can be spread over several years. For instance, to provide seasonal coverage of activities throughout the year, survey work may be required every week. Processing can take several years more. Actual data may be 3 years old before becoming available. The 1990 Census data, collected in April 1990, will be available beginning in late 1992 and early 1993. Surveys conducted every 5 years often must be planned before the results from the previous survey are available for review.

At the same time that these problems exist, new technologies are being developed in the transportation field that may provide opportunities for improving the speed and reducing the cost of data collection. They may also be used to reduce respondent burdens in answering questions and improve the quality of the resulting data.

Some of these new technologies are just emerging; others are more fully developed. In every case, the opportunities for data development provided by these technologies have not been fully evaluated. If these opportunities could be realized, they would make a significant contribution to the development of a data and analytic capability for national policy making at the U.S. Department of Transportation (DOT).

These technologies can be divided into two classes of opportunity with respect to their data development potential:

- New technology-assisted data collection methods to substitute for traditional collection methods (e.g., use of hand-held computers to assist counting and inventorying functions).
- New technological capabilities for performing system management, operating, and administrative functions with potential data spin-offs [e.g., use of electronic data interchange (EDI) between carriers and shippers to provide an automated summary picture of freight movements].

NEW TECHNOLOGY-ASSISTED DATA COLLECTION METHODS

The computer industry is moving rapidly toward miniaturization, greater capability, and lower cost. Many of these capabilities are finding their way into data collection activities.

Computer-Assisted Telephone and Personal Interviewing

Using computers as part of the interviewing process, an interviewer can talk to respondents about their travel activities while the computer keeps track of the information obtained, edits it to clarify contradictory responses, directs the interviewer to appropriate follow-up questions, and enters the records in the appropriate data base in an instantaneous process. Although this is not new to data collection activities in general, particularly in the private sector, its use in the transportation field has been limited. The Federal Highway Administration successfully tested computer-assisted telephone interviewing in its recent National Personal Transportation Study.

Clipboard Computers

Sometimes called palm-top computers, clipboard computers are powerful and as tiny as their name implies. They are capable of storing information quickly at the site of the event to be recorded. They have rapidly developed into a tool for in-factory management control of production processes, delivery systems management (e.g., United Par-

cel Service uses them for package tracking and control), and reading of distant measurement devices (e.g., gas meters).

One of the greatest potential applications in transportation is for police use in on-site accident data recording. The proper recording of traffic crash data by police at the accident scene has always been an obstacle to the collection of meaningful state-level data. The clipboard computer, combining new hardware and software technologies, can markedly improve the quality and utility of data collected by state and local police and other highway safety personnel. It provides the police officer or technician user-friendly direct entry of data into a hand-held computer with built-in editing and coding checks to reduce or eliminate data entry errors. The data can then be directly transferred to statewide computer data bases, reducing the time necessary for paper transfers and data entry.

These approaches and others are being developed quickly and applications are being found in all sectors of the economy and society. The transportation data community does not need to conduct extensive research and development on these technologies; it only needs to remain aware of the potential of these systems, monitor their development, and continually seek new and better applications to transportation.

TRANSPORTATION TECHNOLOGY DEVELOPMENT SPINOFFS

Technologies are being developed in the transportation sector that have the potential for enhancing data collection efforts. Many of these developments involve automated mechanisms to manage and operate the transportation system. Two important areas of emerging capability are intelligent vehicle-highway systems (IVHS) and EDI.

DOT has proposed an increased research and development (R&D) program on IVHS. IVHS refers to a broad range of systems that will use sophisticated microcomputer and communications technology to monitor, guide, or control operation of vehicles and provide travelers with information about highway and travel conditions (TRB 1991). Among the goals of these technologies are increased capacity of existing streets and freeways, safer operational control of vehicles and facilities, and more efficient routing and travel information. These operational activities may also provide opportunities for improved monitoring information about the road system and the activity on it. However, greater efforts

will be required by the transportation data community to fully realize the data potential of these new technologies.

On-Board Vehicle Data Systems

These data systems, available in almost all surface, air, and marine vehicles, generate information for the control and management of the vehicle and its cargo. Effectively all commercial vehicles have available on-board systems that keep track of operations and activities. For example, the trucking industry uses on-board computers that act as complete monitors of truck activity. Such computers routinely report hours of operation, stops and starts, mileage traveled, fuel consumed, idle time, engine revolutions, and even door openings and closings and brake applications. The summation of a sample of equipped trucks could provide a national truck activity data base. The option exists to instrument a vehicle with electronics to incorporate operator-controlled observations about trip purpose, road conditions, or other information.

Traffic Sensing and Control Devices

As roadways increasingly become facilities to be "operated," traffic managers need a continuous stream of real-time data to control operations through ramp meters, traffic monitors, and automated signalization systems. These data, which are generated in real time for operational purposes, could be retained and summarized to support local traffic counts and congestion monitoring programs for energy and pollution monitoring and planning applications.

For example, IVHS technologies permit traffic signals to sense changes in traffic volumes and respond with new signal patterns. If these volume data were stored and saved, they could supplement or replace existing traffic monitoring equipment. Radio devices can now transmit traffic observations to a central point on an instantaneous and continuing basis. A sample set of these devices could provide a national sample of traffic monitoring for daily applications for the broader purposes of pollution management, economic analyses, and congestion monitoring.

Satellite Sensing Systems

Satellites can monitor equipped buses, trucks, and rail cars and their locations at points in time. These systems could provide summary

information on the travel patterns of the vehicles being tracked. For example, satellite tracking systems permit urban buses to be monitored on a continuous basis; buses can be rerouted when delays are apparent. Summary data on schedule adherence and total vehicle travel flows could be gleaned from these systems. Other approaches, using wayside interrogation devices and on-board transponders, provide similar capabilities.

Automated Routing and Scheduling Systems

A number of private firms are developing the capability to route their own vehicles to minimize traffic delays. Other firms provide routing information as a service. As firms further develop this capability, the sum of their activities would be valuable for environmental monitoring by urban planners, traffic engineers, and others. Knowing the route schedules of all the package delivery firms could assist traffic planners.

Automated Ordering, Billing, Taxing, and Control Systems

Private and public agencies (e.g., U.S. Customs Service) are developing automated systems for transferring administrative information. The U.S. railroad industry pioneered the development of these capabilities in the 1970s, primarily for control of cargo moving via more than one railroad. These systems can potentially provide summary data of interest with less cost and nuisance to providers.

CASE STUDY: A DATA APPLICATION OF EDI

Historically, the flow of freight transport has been controlled through paper records. The automation of these records, which is increasingly a standard part of freight documentation and billing, provides immense opportunities for better data on freight flows. Many shippers and carriers now transfer information by EDI. EDI provides for computer-to-computer transfers of large quantities of business information without human intervention. Orders to shippers, requests for freight services, billings from carriers, and payments may all be transmitted electronically (Willenz 1988). The effectiveness of the use of EDI to provide public use summary freight statistics, however, has not been tested.

One of the issues in the development of EDI has been agreement on protocols and standards. Distinct standards exist within industries and countries. EDIFACT (EDI For Administration, Commerce, and Transportation) has been developed as an international standard (Cram 1990). Standardization is applied to the location, size, and formats of data fields and data entry protocols used in computer transmittals.

One major application of EDI is the processing of customs information. Automation of customs declaration documents through an automated manifest system provides the opportunity for better international freight statistics in the ocean trades and air freight services. About 60 percent of import transactions was handled by EDI in 1986. A goal of 90 percent has been set. So far, data indicate that 86 percent of all import transactions is now being handled electronically (Farrell and Radspieler 1990). The statistical improvement in time and cost is enormous. Before electronic transfer, physical records were received and processed by the U.S. Customs Service, mailed to the Bureau of the Census processing facility in Indiana, keyed into computer formats, and edited. Errors might be discovered during editing—30 days after receipt. Now the edits defined by the Census Bureau are embedded in the Customs Service computers, which edit data continuously as they are received. Errors are corrected instantaneously. These records provide a powerful source of information on in-bound freight flows. Linkage of these records to domestic freight documents could provide valuable data on international trade activities. In fiscal year 1993 the two bureaus will begin to automate export data in a similar system.

A Commodity Flow Survey (CFS) is under design by DOT and the Bureau of the Census. This survey would measure the flows of all goods moving between major areas of the country. Such a survey, although valuable, is also difficult and costly to design and perform. Past surveys have suffered from inadequate funding and faulty design. One of the key issues in the current design process is the treatment of goods moving in foreign trade, either as imports or exports.

The fundamental survey approach is to collect information on shipments from a selected set of sample establishments to all destination establishments. Difficulty arises when the flows to be measured are either received as imports or intended for export. In the case of imports, the shipping establishment is a foreign entity and therefore not accessible to be part of the sample of establishments. If the receiving establishment is close to the port of entry, then no domestic travel of significance is likely to be lost. If the receiving establishment is inland, all the domestic travel of the import journey is unknown, and the

survey's overall effectiveness is impeded. As the number of imports grows, a significant share of total national freight movements will be missed.

Further, unless all respondents are encumbered with a "Did you import anything?" question, all specific identification of imports is lost (i.e., the flow of imports in the domestic transportation system cannot be traced). Analyses of record-keeping practices indicate that only a small percentage of all establishments engage in exports or imports, and most establishments cannot answer such questions effectively. Thus, unless a convoluted and complex set of questions is to be asked of all respondents, there does not seem to be an effective method to obtain import flows data as part of the CFS, given its current design. These are important data to have. Beyond their transportation value, which is considerable, they have great public policy significance. They will permit analysis of U.S. experience against foreign competition and permit response to questions of which states and areas are exporting or importing which products.

To overcome these problems, consideration is being given to linking domestic flow data obtained by survey means with the records obtained administratively for all imports and exports by the U.S. Customs Service. Documents collected by the Customs Service and compiled by the Foreign Trade Division of the Bureau of the Census will be evaluated for their ability to substitute for survey records regarding points of entry, mode of transport, and final destination of the imported products. These documents, required for regulatory and administrative applications, are increasingly available via EDI as described previously. Melding two disparate data sets such as these is a significant statistical and data processing task, but its superiority over the alternatives is overwhelming. If this approach is successful, it can provide crucial data that would otherwise be unavailable except at great public cost and respondent burden.

The issue regarding exports parallels the import problem, but because of the nature of the sampling process, the concern is more one of double counting and not loss of information. Again, the export document records of the U.S. Customs Service can provide a major cost saving and data enhancement opportunity.

These data have many potential uses. A valuable understanding of future freight trends, for example, is possible if a better sense of the miles of movement of tonnages of varying products can be calculated and the mileage "multipliers" associated with a domestic versus a similar imported product can be constructed. Total ton-miles of travel

per unit of gross national product has been declining in recent years. One factor that could explain this is that the substitution of foreign imports for domestic products reduces the total transport requirement (i.e., the sum of all the ton-miles of steel, plastic, glass, etc. to fabricate a domestic automobile is far greater than the ton-miles involved in shipping an import from the dock to the dealer). These substitution effects are poorly understood, but will have important bearing on future transport requirements. Ports would also find these data a valuable planning and marketing tool. State officials are increasingly interested in export and import activity as part of statewide economic planning. They ask, "What do we export? Where does it go?" Finally, these data would provide important information for public policy purposes on the flows of imports and exports and their impacts on transportation, employment, and the general economy.

The importance of these data for the needs of the Secretary of DOT is wide ranging. The secretary has made better commodity flow information a data development priority (DOT 1990, 124). The secretary's main interest in commodity flow information is expansion of the department's ability to monitor intermodal freight movements and address national freight movement capacity issues. The current interest in the role of intermodal flows is a significant part of the considerations surrounding pending legislation on surface transportation. Moreover, the secretary recognizes the need for a set of general purpose freight data to respond to unknown and unanticipated freight-related policy issues in the future. Ancillary interests include systems performance inputs, ports utilization information, and foreign trade flow information. If these data can be obtained quickly, at lower cost, and with less respondent burden, the objectives of the secretary will be materially enhanced.

TECHNOLOGIES FOR DATA ANALYSIS: GEOGRAPHIC INFORMATION SYSTEMS

No discussion of technologies for data collection and analysis would be complete without mention of geographic information systems (GIS). Although GIS have been in existence for decades and thus are not technically a "new" technology, their full capabilities only began to be exploited in the past decade as a result of development in computing capabilities (e.g., the personal computer and computer graphics).

GIS are computer-based data systems with a strong spatial component in which data elements are identified by their spatial location and

are organized, manipulated, and displayed in spatial terms, generally maps. (Data may be represented spatially as points, lines, or areas.) GIS consist of five essential elements: data acquisition, preprocessing, data management, manipulation, and analysis (Star and Estes 1990). The systems allow for the integration of spatial geographic data with descriptive analytic data.

Transportation is one of the most spatial of information areas and thus lends itself to GIS applications. GIS provide a powerful tool for overlaying modal data to make intermodal comparisons and analyze systemwide impacts of changes in the demand or supply of transportation services. The development of a data base—the national transportation network data base—integrated into a GIS for strategic transportation defense planning is described in Chapter 3. Another GIS application for policy analysis would be to produce maps linking highway, rail, and waterway transportation routes with commodity flow data on these routes. By overlaying these data, analysts could readily see the effect of modifying flow rates and the impact this would have on the entire system. Constraints on various parts of the system could be imposed to further understand the impacts of changes in freight flows.

Another application might focus on safety. Accident data on the various transportation systems could be merged with exposure data over time, and a visual image of the multimodal safety of the system could be constructed. Then, the effects of modifying the exposure by changing traffic flows, for example, could be modeled to show the impact that such changes would have on the safety of the entire system.

FINDINGS AND RECOMMENDATIONS

Just as DOT's multimodal data needs have been neglected, so have research activities on methods to collect and analyze data more cost-effectively. The opportunities and the needs at this time could not be greater. Major policy questions are being raised. If the data development capabilities of such new technological programs as EDI and IVHS are recognized at this early stage, they can be effectively incorporated into the long-term structure of these programs. A number of questions should be answered:

- What new technological advances in the transportation sector can prospectively provide opportunities for enhanced data development and analysis?

- How can these new technological developments help
  - -Reduce the costs of data collection, processing, and analysis?
  - -Speed data collection and reporting?
  - -Reduce reporting burdens?
  - -Enhance the quality and utility of data and analysis?

To address these questions, the department should conduct a thorough survey and review of the potential application of advanced technologies for improved data collection and analysis. It should incorporate into the department's own IVHS R&D program the goal of analyzing the data collection potential of design, planning, and monitoring information. DOT should give priority consideration to opportunities for the use of administrative records, EDI in particular, as an enhanced means of rapid, inexpensive data collection. Finally, the department should expedite development of its GIS capabilities for multimodal data analysis.

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